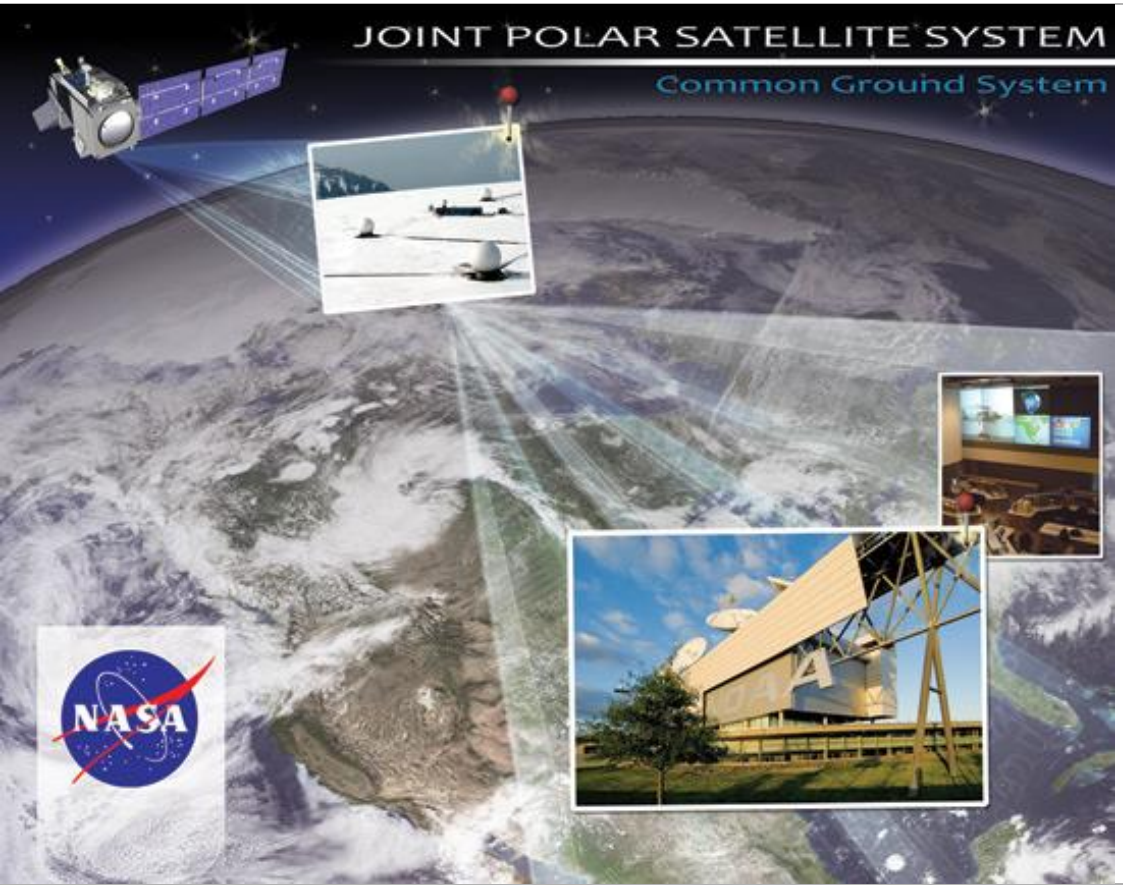


SUOMI NPP SDR Science and Validated Product Maturity Review -

NCWCP Auditorium, College Park, MD

IDPS Implementation Process

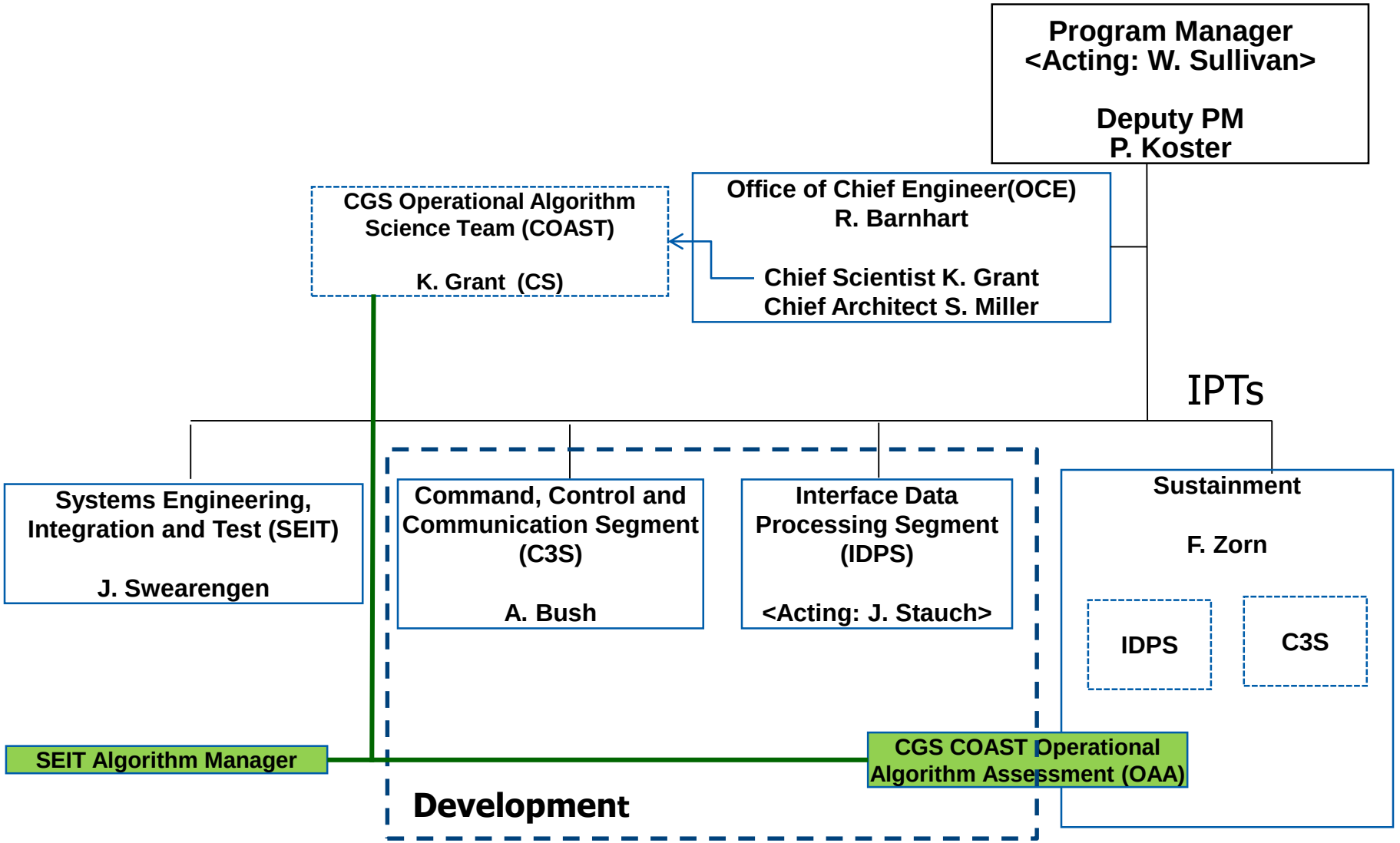
Wael Ibrahim/Kerry Grant

December 20, 2013

Outline

- Algorithm Lifecycle – CGS Support [3]
- Algorithm Change – Modified Approach [4]
- Sustainment Mx Support [3]
- Development Blk 2.x Support [5]
- Mission Data Support [1]
- Analysis Tool Development [1]
- Accelerated Release Cycle [4]
- Backup [41]

Algorithm Lifecycle – CGS Support (1/3)
JPSS CGS Organization

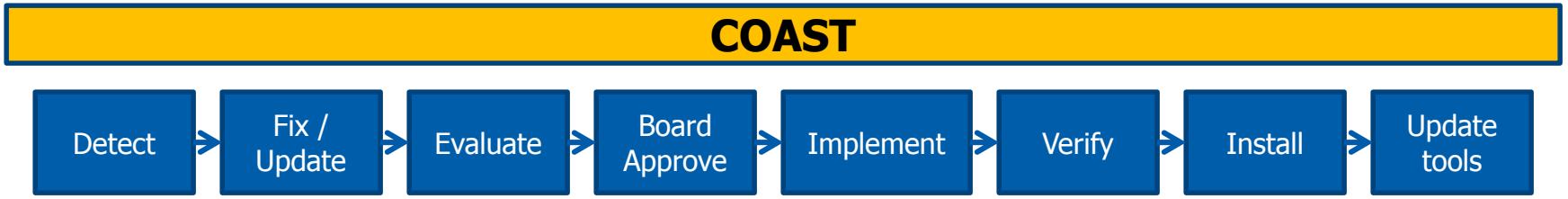


Algorithm Lifecycle – CGS Support (2/3) COAST Charter

- COAST is a virtual IPT, supporting the JPSS CGS algorithm activities, to ensure algorithm activities are efficient, effective, coordinated, and timely
- Includes Intensive Cal/Val, algorithm assessment, recommended algorithm updates, algorithm verification, and algorithm management (e.g., giver/receivers)
- Quantitatively assess and ensure the correct implementation of the operational algorithms through the evaluation of the quality produced within the data products (SDRs, EDRs, IPs, GEOs, etc.)
- Develop, integrate, and utilize Data Quality Analysis Tools
- Support sustainment/development activities to update, implement, and deploy operational algorithms

COAST acts as CGS POC for all Algorithm-related interfaces to NASA/NOAA DPE/DPA/STAR/OSPO groups

Algorithm Lifecycle – CGS Support (3/3) COAST View



	Detect	Fix / Update	Evaluate	Board Approve	Implement	Verify	Install	Update tools
RTN	OAA Sust SW/SE IDPS SW/SE	OAA Sust SW IDPS SW	OAA Sust SE IDPS SE	CS	OAA Sust SW IDPS SW	OAA Sust SE IDPS SE	Sust MST Sust INT	OAA Sust SW/SE IDPS SW/SE
Gvt	Science Teams DQST DQE	Science Teams	DPE DQST DQE	DPA DPE JPSS IDPS	DPE DQST DQE	DPA DPE DQST DQE	DPE	Science Teams DPE DQST DQE
H/W	OPS (I&T) GRAVITE ICF Factory GISF Factory IDPS OAA HW	GRAVITE ICF Factory GISF Factory IDPS	OPS I&T GRAVITE Factory GISF Factory IDPS OAA HW		OPS I&T Factory GISF Factory IDPS	OPS I&T GRAVITE Factory GISF Factory IDPS OAA HW	OPS I&T	GRAVITE ICF Factory GISF Factory IDPS OAA HW

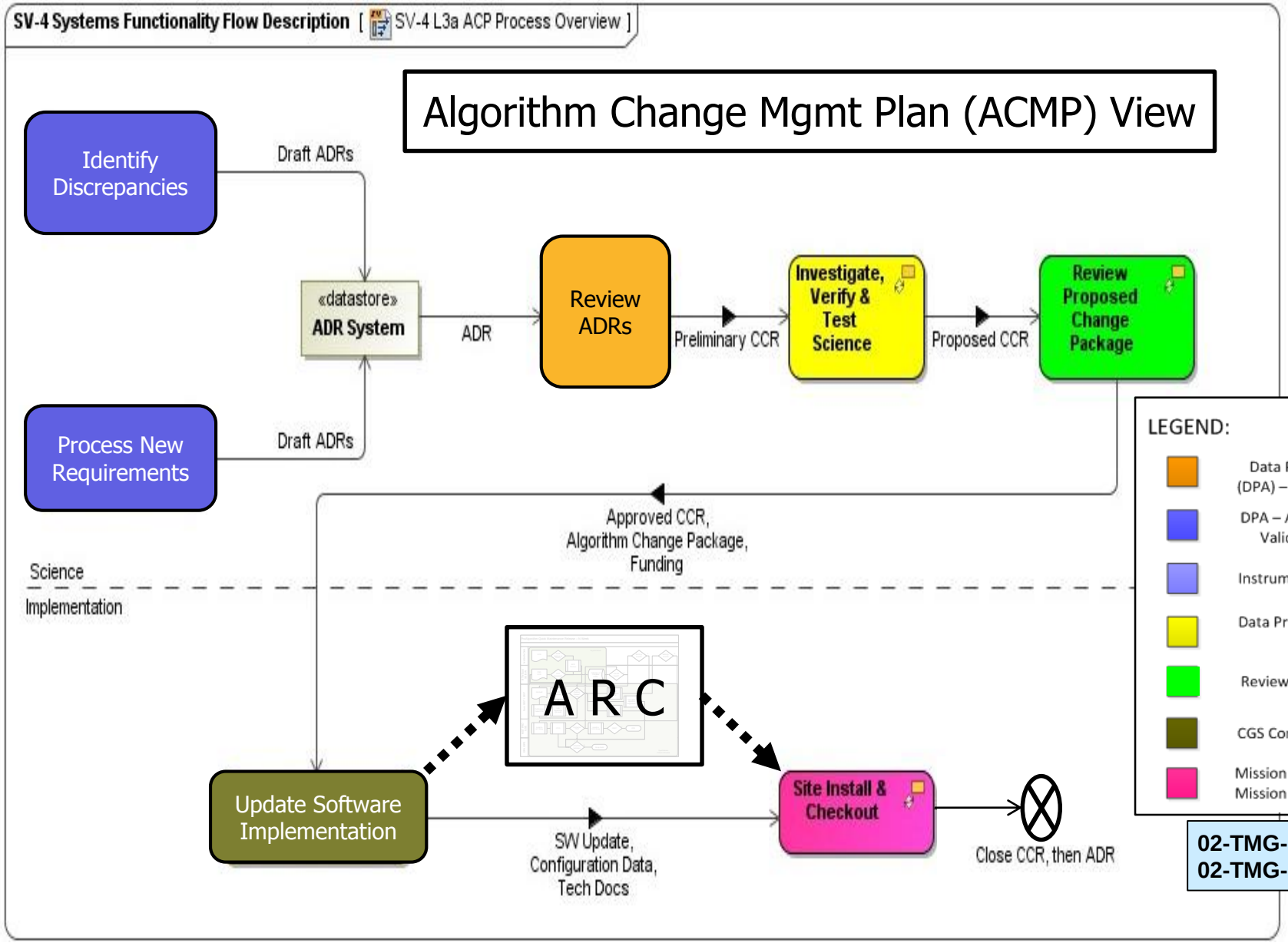
Key: RTN CGS: CS, OAA, Sustainment, IDPS
Government: Science Teams, DPA, DPE, DQST, DQE, Operator, GRAVITE, etc.

Algorithm Change – Modified Approach (1/4)

- "Block 1.2" S-NPP processes, design, and tools applied to Algorithm Change in "Block 2.0"
- Project's Algorithm Change Management Plan (ACMP) sets overall approach
  - COAST manages Raytheon activities within context of ACMP
- Rapid accommodation of algorithms into operational system enabled by process, design and tool features
  - Early integration of science and engineering teams mitigates technical and schedule risks and reduces rework
  - Algorithm Development Library (ADL) and Binary Algorithm Adapter (BAA) speed operationalization
  - Testing approach maintains strong pedigree to comprehensive S-NPP test campaign, while reducing cycle time
  - Accelerated Release Cycle (ARC) shortens time to implement in OPS

Block 1.2 Lessons Learned Used to Refine Process, Tools and Design

Algorithm Change – Modified Approach (2/4)



02-TMG-GSCDR-04
02-TMG-GSCDR-08

Algorithm Change – Modified Approach (3/4)

- The traditional waterfall approach where algorithm science team develops/tests algorithm updates then provides the algorithm update package to Raytheon CGS to implement has been inefficient.
- The modified approach is built on a more collaborative relationship to achieve higher efficiencies and rapid implementation.

Algorithm Change – Modified Approach (4/4)

Phase	Activity	Flow
Science Development	Algorithm science team, STAR AIT, and Raytheon stand up a collaborative development environment	
	DPA coordinates TIMs with all stakeholders	
	Algorithm science team, STAR AIT, and Raytheon collaborate on initial ADL version of the algorithm update to ensure operational aspects are considered/well-understood up front, interfaces identified, adequate test dataset socialized, impact to downstream algorithms assessed, etc.	
Initial Algorithm Change Package (ACP)	STAR AIT creates package and performs initial tests; DPA, DPE AIT and COAST review. Package provided to DPE	
NASA Integration and Verification of ACP	DPE completes ACP, AERB approves and drops to Raytheon IDPS/Sustainment	
Operationalization/Integration at Factory	Raytheon integrates ACP into operational baseline, executes performance and B2B tests at factory, receives feedback from DPA	
ARC	Package goes into "Consolidated" Accelerated Release Cycle (Sustainment/Development)	
Verification	Verification event executed for requirements sell-off	

Sustainment Mx Support (1/3)

- DR Lifecycle
  - Initial interaction w/ Science teams during which issue is socialized before formally being elevated to a DR (OAA provides feedback/quick investigation)
  - Once DR is formalized, OAA socializes the DR w/ Sustainment and works w/ algorithm JAM/Cal-Val team on the CCR package content (ensures completeness, adequate test data, impacted ICDs are accounted for, impacted downstream algorithms are accounted for, etc.)
  - Once CCR package is received, OAA works with Sustainment (provide technical guidance to SW RE and collaborates w/ SE RE on CCR impacts) and IDPS (if any impacts to Development)
  - Coordinate TIM(s) w/ Cal/Val team(s)
  - DR/CCR → PCR: OAA works with SW RE and provide guidance when it's needed on implementation, supports Unit Test "UT" verification

Sustainment Mx Support (2/3)

- DR Lifecycle (Cont.)
  - PCR → Build: Verify (on the integrated chain level) that implemented change resulted in the intended results and no unintended side effects are present.
- Algorithm Quality-related PCR Verification
  - Previous step of UT–level PCR verification (using stand-alone algorithm update) ensures algorithm update per implemented PCR meets the intent of that algorithm change.
  - This step uses the actual build, where that algorithm change is merged into, and repeats the previous UT-level verification steps to ensure algorithm change merged correctly and no unintended side effects of that algorithm update WRT other merged algorithm updates.

Sustainment Mx Support (3/3)

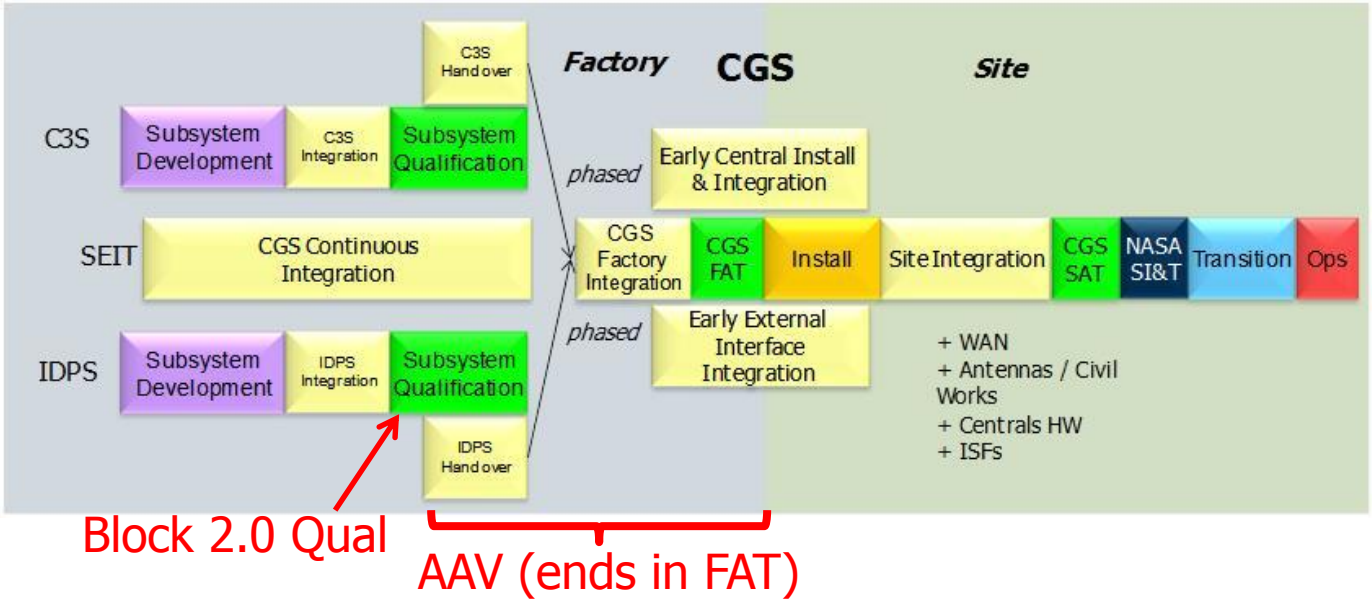
- Build-2-Build Checkout/Verification
  - B2B activity/artifacts are part of the Sustainment Mx SW Release Review (SW RR) package.
  - Artifacts are provided to DPA to ensure/show the level of rigor followed to test the implemented changes in the delivered Mx build.
  - More on the B2B activity in the “BACKUP” section.

Development Blk 2.x Support (1/5)

- Similar to Sustainment Mx Support tasks (i.e., B2B activity, PCR verification, etc.) but on the IDPS development side.
- Liaison b/n Sustainment and IDPS to ensure all algorithm related issues are addressed properly across Sustainment and Development.
- Development POC collaborating w/ Science teams for J1 algorithm updates.
- Support SRS reviews.
- Support Algorithm Assessment Verification (AAV) related testing activity (more on AAV in the following slides)

Development Blk 2.x Support (2/5)

- AAV Plan
  - Provides the plans and methodology for verification of IDPS Processing (PRO) requirements during IDPS Block 2.0 AAV event.
  - AAV event is the timeframe for the verification of the PRO algorithm-related requirements; these requirements have a verification method of "Analysis and Test."
  - The data is produced in the QUAL Increment 3 test event and the analysis is performed in the AAV event timeframe.
  - Factory Acceptance Test (FAT) and Site Acceptance Test (SAT) activities are the responsibility of the JPSS CGS Systems Engineering, Integration, and Test (SEIT) organization and are therefore not covered in AAV plan.



CGS IV&T Approach

Note: Block 2.0 QUAL is composed of 4 mini QUAL events, i.e., Increments 1, 2, 3 & 4

Development Blk 2.x Support (3/5)

- AAV Plan (Cont.)
  - AAV requirements refer to the EDRPR* in the requirement wording, and are organized per product. Every product has up to 3 separate requirements:
    - For the “Basic Functionality” of the algorithm: The Processing SI shall generate the xxx xDR as specified in Section a.b of the JPSS Environmental Data Record (EDR) Production Report for S-NPP, 474-00012.
    - For the algorithm Exclusions and fill: The Processing SI shall provide fill values for the xxx xDR in accordance with Section a.b of the JPSS Environmental Data Record (EDR) Production Report for S-NPP, 474-00012.
    - For quality Flag implementation: The Processing SI shall generate the xxx xDR Quality Flags that are listed in Table a-b of the JPSS Environmental Data Record (EDR) Production Report for S-NPP, 474-00012.

*Although SRS docs are now (as of 10/31/13) under contract, i.e., official, however, currently algorithm-related requirements still reference EDR-PR. These requirements will be updated to reference the appropriate SRS volumes once SRSs are approved (planned at the 1/8/2014 AERB).

SRS Volume	CM Board	Technical Jurisdiction	Heritage
1	Ground ERB	NASA CM	EDR-PR, EDR-IR
2	Ground ERB	Raytheon	CDFCB
3	AERB	Raytheon	OAD
4	AERB	DPA	EDR-PR QF Table

Development Blk 2.x Support (4/5)

- AAV Plan (Cont.)
  - The verification of the 3 types of requirements utilizes a common strategy:
    - Continuous pedigree (or lineage) of the Build to Build (B2B) Quality Assessment
      - Ensures updates to the operational “sustainment” and development baselines have been evaluated for algorithm performance.
      - Maintained along the sustainment baseline until is transferred over to development.
      - B2B check will be done using a semi-automated analysis process using the Quantitative Algorithm Analysis Criteria (QAAC).
      - QAAC will be made up of a range of allowable differences for each algorithm between the operational sustainment baseline and Block 2.0 development baseline.
      - Allowable differences are expected because of platform differences as well as functionality affecting algorithm results that may be in one baseline but not in the other.
    - Specific tests for algorithm production Exclusions and Fill Values
      - Use appropriate datasets needed to trigger the specific conditions tested.
      - Tests are documented in the pertaining algorithm sections in the AAV Analysis and Inspection Report (AIR).
    - Specific tests for Quality Flag (QF) triggers
      - In most cases these tests require specific Non-nominal datasets.
      - QF testing is documented “AAV Plan” and has been communicated with the various algorithm Cal/Val and Science teams.
      - AA QFs are tested mainly in the B2B process and then only a subset are further tested with special datasets.
      - Tests are documented in the pertaining algorithm sections in the AAV AIR.

Development Blk 2.x Support (5/5)

- PCR Verification
  - A PCR is a Problem Change Report / Request – either a discrepancy or change to Code, HW, Configuration or Document.
  - A PCR is categorized as
    - Path A: Used during Design/Code and Unit Test “CUT” for developers tracking internal problems
    - Path B: Detected after the associated Build’s Integration Readiness Review “IRR” but before Test Readiness Review (TRR)
    - Path C: Noncompliant requirements (Failed or re-opened based on PCR/ECR flowdown)
  - Path C is a more efficient (cost and schedule) way to get new functionality into a baseline when
    - the requirement functionality has already completed a verification event or
    - the requirement fails during the normal verification cycle.
  - Path C process requires additional formal steps to verify that the PCR fix is correct.
    - Note: New QFs that are implemented in operations during S-NPP Intensive Cal/Val phase are verified as part of the sustainment maintenance release process are documented in a Path C PCR Supplemental AIRs (S-AIR).

Mission Data Support

- Develop test data to support OAA analyses
- Support IDPS/Sustainment/SEIT mission test data needs
  - Mission: SNPP, J1
  - Dataset characteristics: focus day, none-nominal
  - Purpose: B2B, PCR verification, DR/CCR support
  - More on the development of “focus day” dataset in the “BACKUP” section.

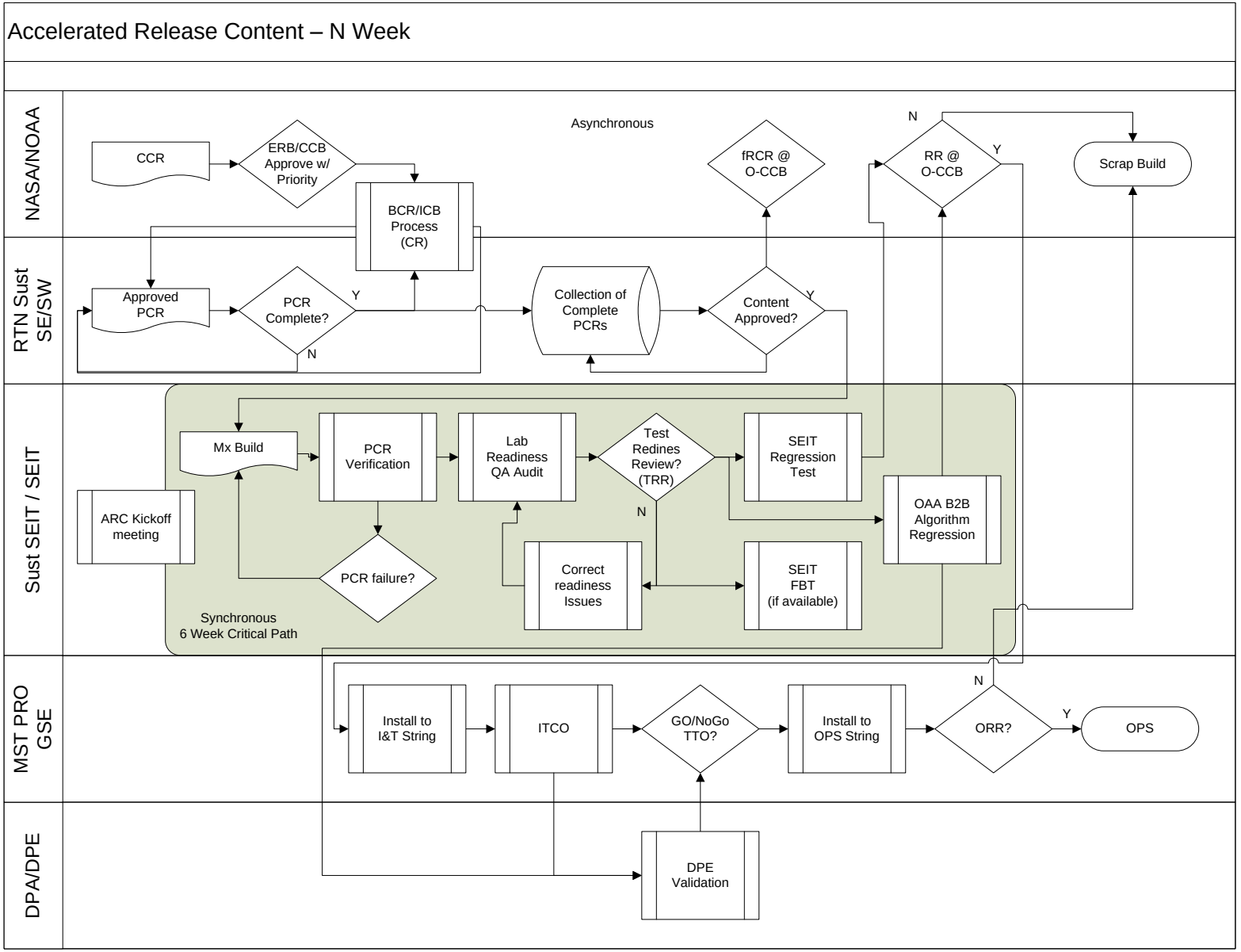
Analysis Tool Development

- Develop a Tool Suite that is expandable, flexible, configurable, scalable, object oriented, adheres to SW standards
- Share with Cal/Val teams developed quantitative analysis tools (e.g., DQL, QCV tool suite, IDPS2KMZ and Selective Granule Finder)
- Tool suite offers unique capabilities to test and evaluate the impact of software code, LUT or PCT changes on algorithm performance including output SDR/GEO/EDR/IP.
- The Selective Granule Finder allows Cal/Val teams the ability quantitatively discriminate/identify desirable NPP granules based on combinations of specific geophysical parameters of interest.
- OAA is continuously enhancing and adding more tools to its tool suite to provide more efficient methods/processes to support algorithm related analyses.
- More on OAA Tool Suite in the “BACKUP” section.

Accelerated Release Cycle (1/4)

- ARC process is created to establish regular, efficient and "quick" release cycle for IDPS "Sustainment/Development" software releases to support algorithm updates for the remainder of SNPP Cal/Val and incorporation of J1 algorithm changes.
- Although ARC process primarily intended to support algorithm-only releases, however, additional content (none algorithm related) may be accommodated as approved by the Implementation Control Board (ICB).
  - Additional content may extend dry run, regression, and ITCO periods
- No more code cutoff condition levied on Science teams to meet a specific build deadline
  - For Mx8.3 (1st ARC), internal code cutoff to merge Sustainment SW code updates is 1/13/14

Accelerated Release Cycle (2/4)



Accelerated Release Cycle (3/4)

- Consolidated Block 1.2/Block 2.0 ARC
  - Approach is driven per a concern regarding synchronizing algorithm updates for Block 1.2 along with Block 2.0
    - Requirement to maintain both baselines with current changes
    - Must maintain algorithm quality
  - Approach is based on combining algorithm management efforts for both Sustainment (Block 1.2) and Development (Block 2.0)
  - Consolidated ARC approach would handle algorithm updates through an efficient and consolidated effort
    - Currently, most algorithm updates from Sustainment Mx builds are not captured in Development “synch-ed w/ Block 2.x builds” until 3-4 months later
    - Currently, resynch efforts are complex and convoluted due to divergent baselines
    - Duplication of OAA activity supporting multiple baselines (Mx and Blk 2.x) based on split schedules, i.e.,
      - Supporting SW RE during algorithm update implementation (Sci2Ops), e.g., UT analysis, review
      - Supporting PCR verification once algorithm update is merged into a build

Accelerated Release Cycle (4/4)

- Consolidated Block 1.2/Block 2.0 ARC (Cont.)
  - Supporting B2B
    - » Sustainment: Mx AIX B2B, Mx ADL Linux vs Mx AIX B2B
    - » Development: Block 2.0 Linux vs Mx AIX B2B
  - Aforementioned activity is doubled per algorithm update when that change is implemented separately (separate PCRs) in Sustainment and Development builds
  - Consolidating the algorithm update effort for both Sustainment and Development will consolidate OAA aforementioned efforts, thus resulting in savings (resources, schedule)
  - More on the “consolidated ARC” in the “BACKUP” section.

BACKUP

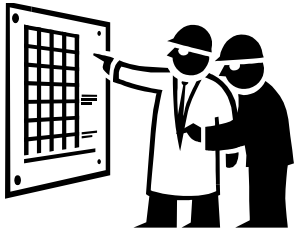
BACKUP
BUILD-TO-BUILD

Build-to-Build Assessment (1/11) - Objectives

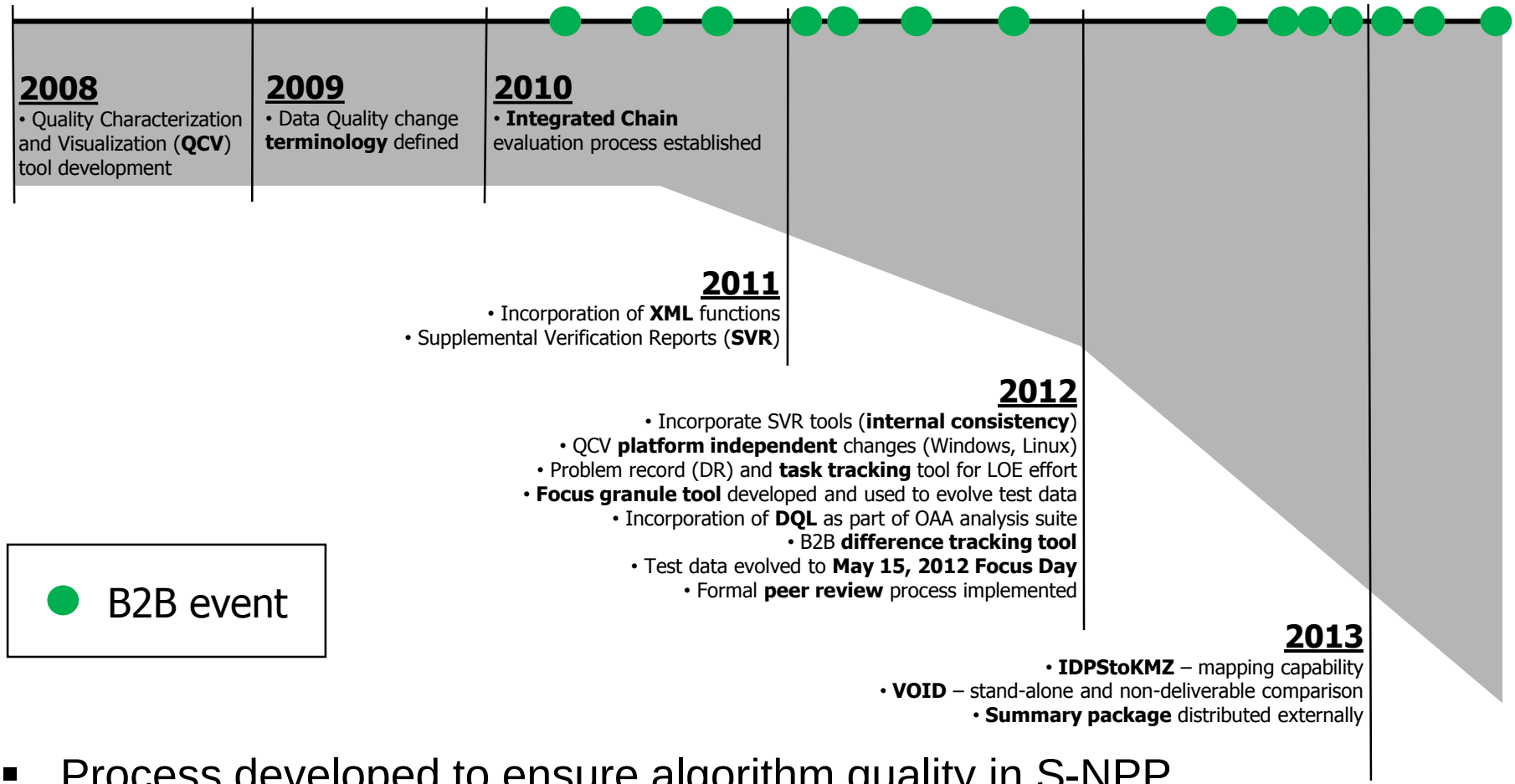
- Data quality
  - Evaluate a sufficient spectrum of environmental scene conditions, using controlled input data, produced by an integrated environment as near to OPS-like as is feasible, to ensure Operational quality performance and to match intent of science community
  - Characterize change: Detect, attribute, verify (maintain algorithm pedigree)

- Operational issue avoidance
  - Produce data and analysis such that unexpected problems can be detected and eliminated before delivery to OPS
  - Characterize complex systemic problems to facilitate communication

- Collaboration
  - Work with Cal/Val to (1) understand change intent (early), (2) discuss anomalies and downstream impacts (later), (3) verify schedule and change scope to IDPS I&T and OPS strings (post deployment)
  - Work with Sustainment closely to investigate unexpected change
  - Work with IDPS/SEIT frequently to communicate and approve analysis



Build-2-Build Assessment (2/11) - Evolution Milestones



- Process developed to ensure algorithm quality in S-NPP
  - 14 Sustainment evaluations performed to date, started in May 2010 with Mx2 to SC7.1
  - 165 PCRs generated through specifically OAA B2B evaluations since inception
    - 77 additional PCRs from SVRs

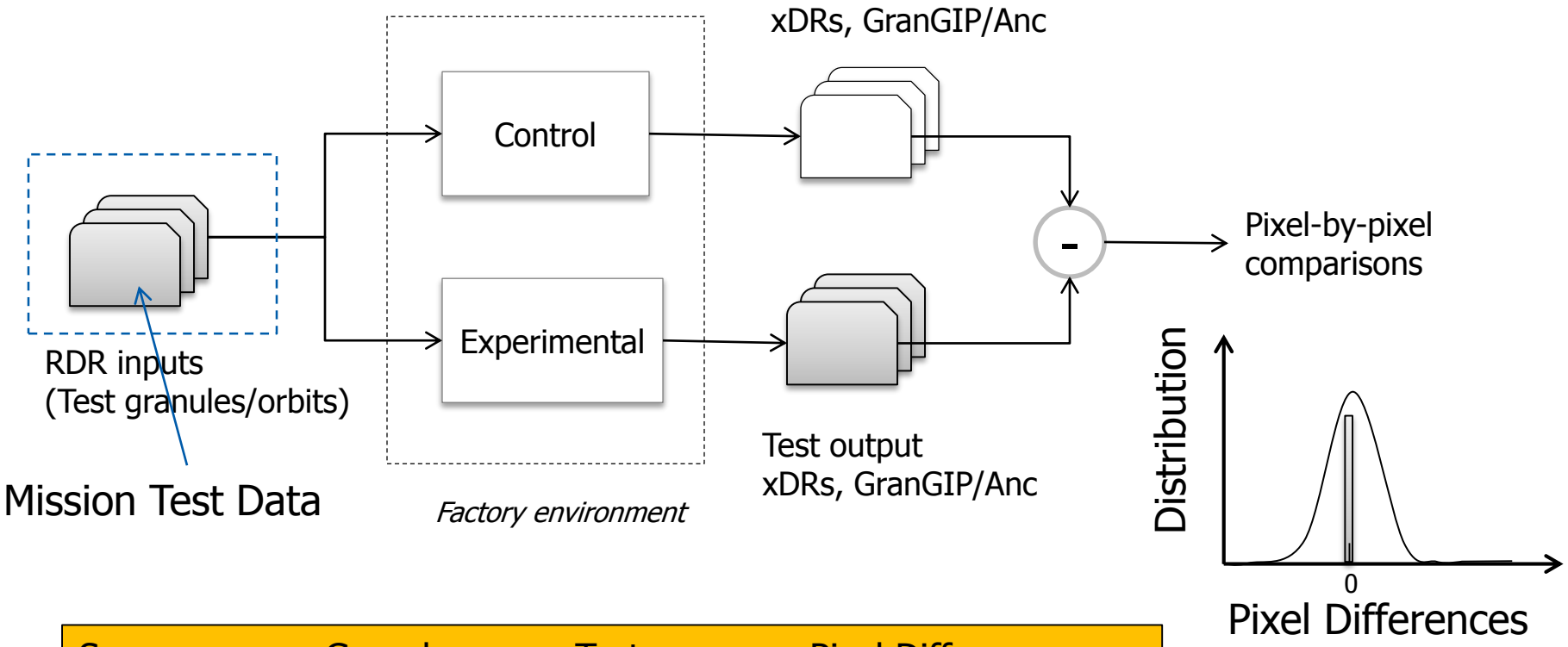
Build-2-Build Assessment (3/11) - Overview (1/2)

- Planning - technical decoupling (function from algorithm) to maintain focus on algorithm pedigree – as needed
- Execute and generate data – 2-4 days
- Analysis and results – 1-7 weeks*
  - The machine tells us what is different, analysts determine difference "goodness"
  - Evaluate all non-zero differences, monitor results for human-injected errors
  - Three types of change:
    1. Expected change – CCRs, DRs, PCRs ("easy")
    2. Unexpected change – man-made patterns ("easy" to "medium")
    3. Unexpected change – organic patterns ("medium" to "difficult")

    Time consumers
  - Raytheon supports, but does not decide on, Science performance
    - This is a Cal/Val objective
- Peer Review and adjudication – 1 week
  - Review is performed as analysis results are available
  - We do not wait until the end of analysis

* Calendar time

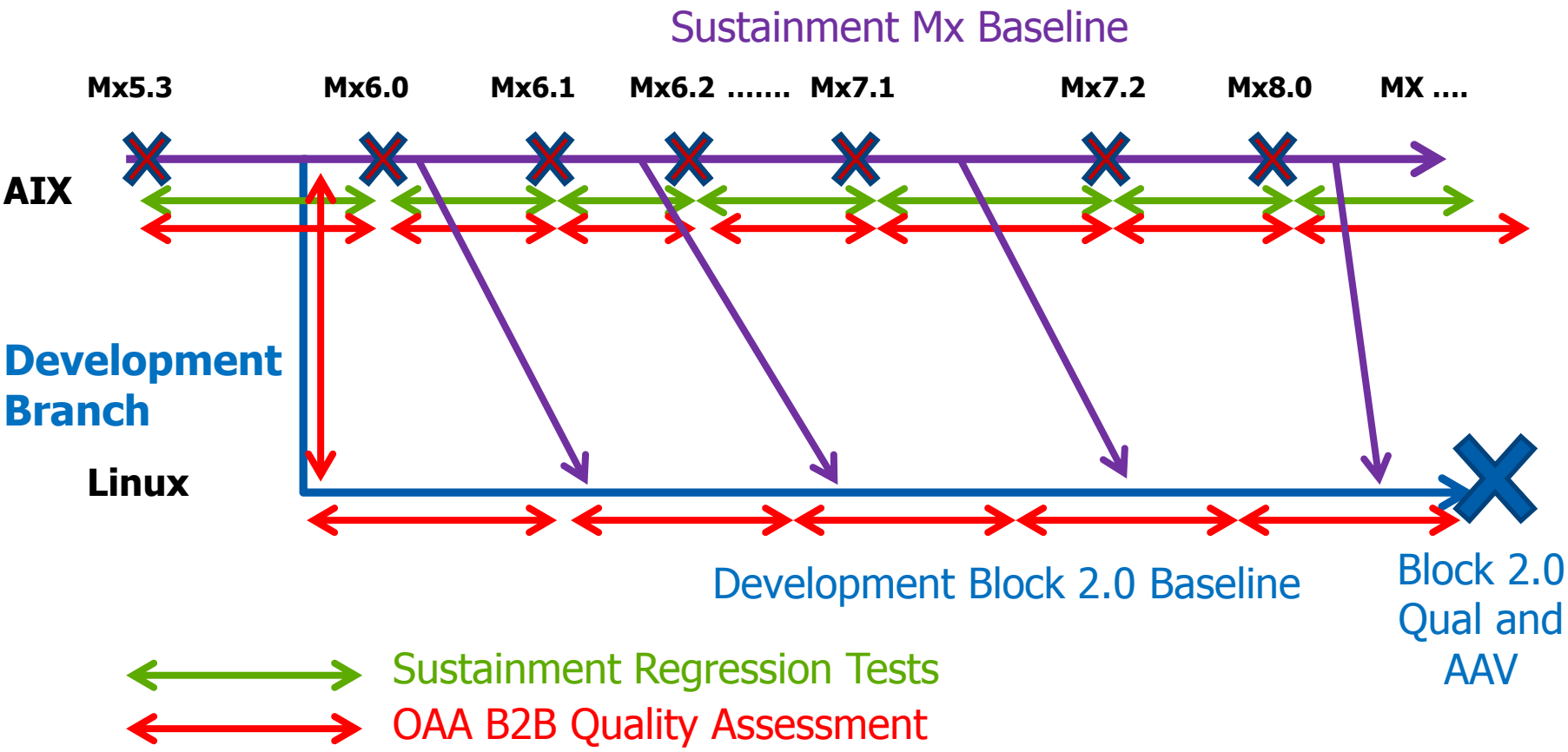
Build-2-Build Assessment (4/11) - Overview (2/2)



Sensor	Granules	Tests	Pixel Differences
VIIRS	22	69,136	97 B
CrIS	384	4,643	2 B
ATMS	384	774	80 M
OMPS	161	580	32 M
CrIMSS	384	247	110 M

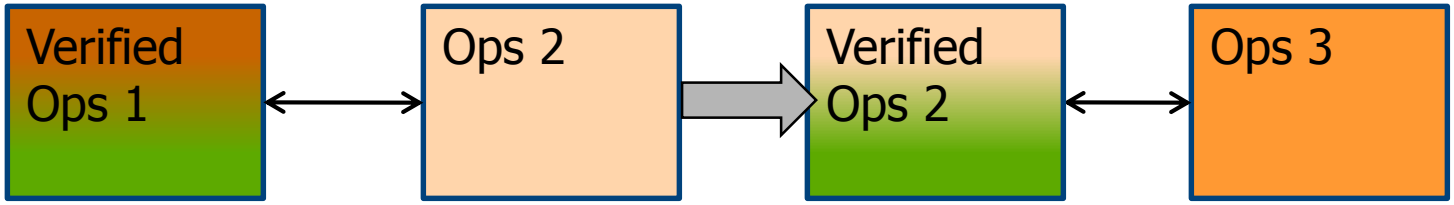
Build-2-Build Assessment (5/11) - Mx-to-Block 2.0

- Encompasses Sustainment Mx builds, Development Block 2.0 builds, Merges from Sustainment to Dev

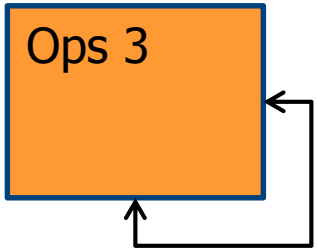


Build-2-Build Assessment (6/11) - Algorithm Pedigree

- IDPS to IDPS (Verified Ops from *prior* build to Ops)



- IDPS to IDPS-Truth (Verified Ops from *same* build to Ops)

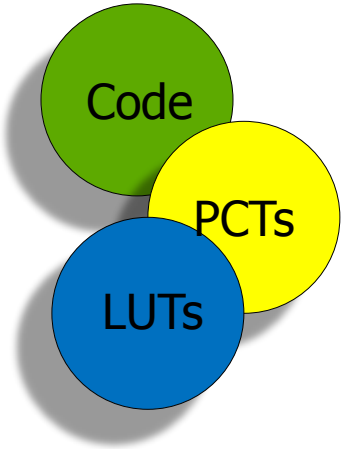


Build-2-Build Assessment (7/11) - Analysis Process Overview

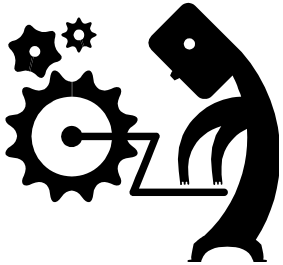
- (**A**)nticipate
  - Anticipate, understand, and prepare for IDPS change
  - Translate scope of science change to our analysis data and environment
- (**F**)ind/(**F**)ix
  - B2B clock starts
  - Monitor and evaluate intended change (date/time, type, nature, scope, impact)
- (**T**)arget/(**T**)rack
  - Implement focused monitoring (spatial, temporal, phenomenology)
  - Engineering judgment, collaboration (science knowledge-base)
- (**E**)ngage/(**A**)ssess
  - B2B clock ends
  - Customers, management, mission partners (result-based)

Build-2-Build Assessment (8/11) - Pre-B2B Activity

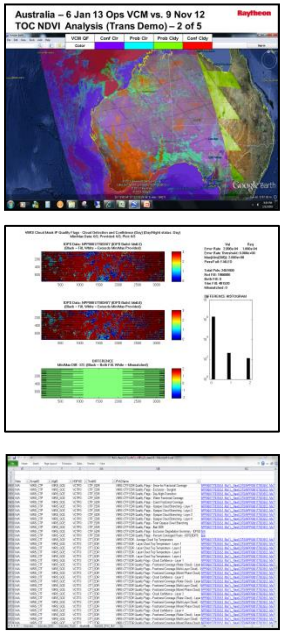
- (**A**)nticipate
  - Anticipate, understand, and prepare for IDPS change
  - Translate scope of science change to our analysis data and environment



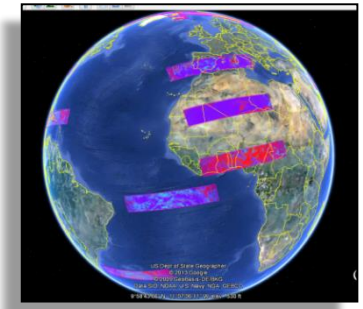
IDPS change drivers (CCRs, DRs, PCRs)



Sustainment development and PCR Peer Review (Unit Test)



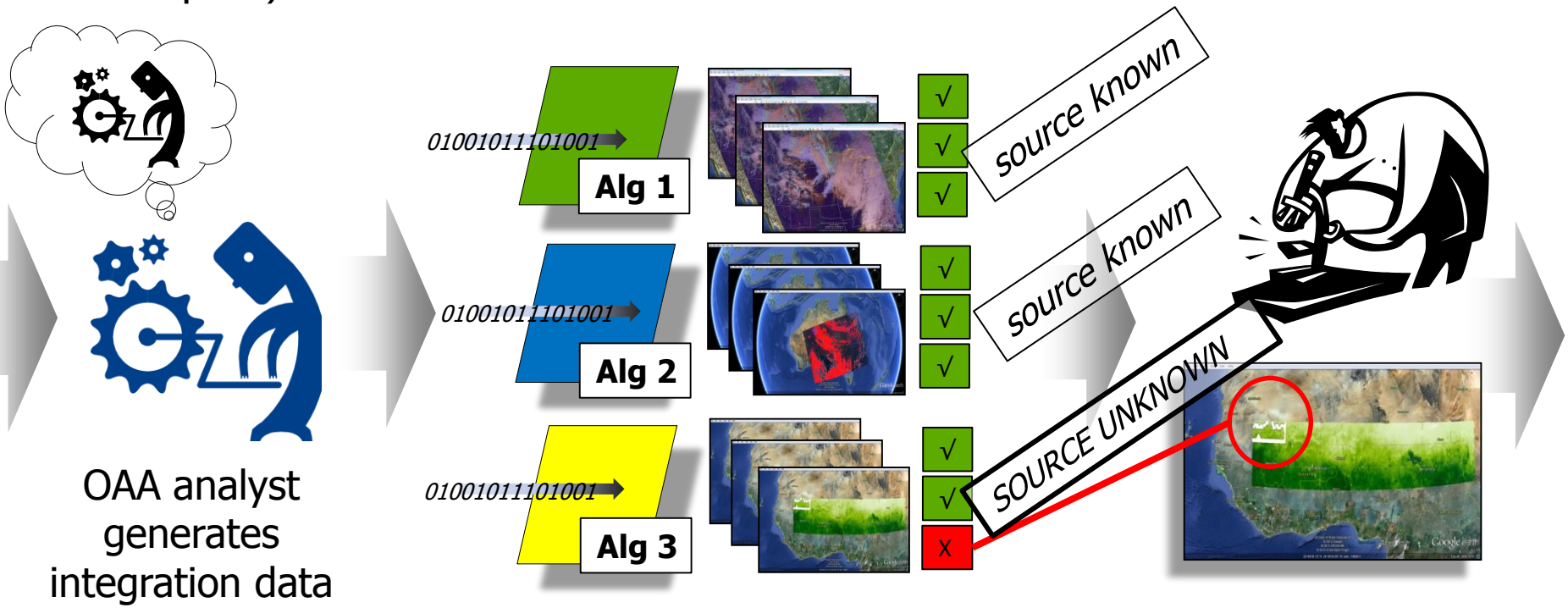
OAA generates analysis artifacts (Characterize)



Provide analysis artifacts to PCR Peer Review

Build-2-Build Assessment (9/11) - B2B Execution and Analysis

- (**F**)ind/(**F**)ix
  - Monitor and evaluate intended change (date/time, type, nature, scope, impact)



OAA analyst generates integration data

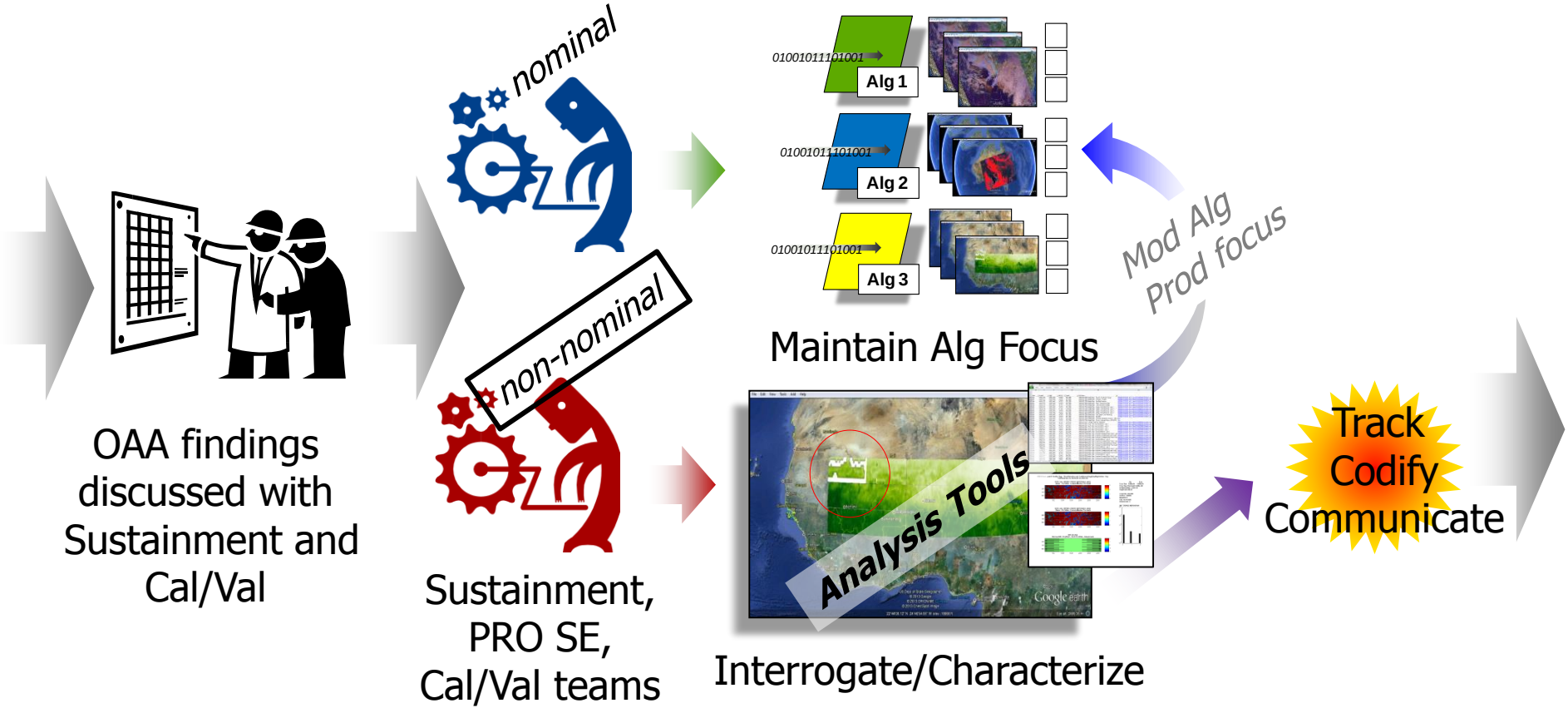
B2B clock starts

OAA analyze implemented changes (*parallel*)

Unknown or unexpected source of change detected

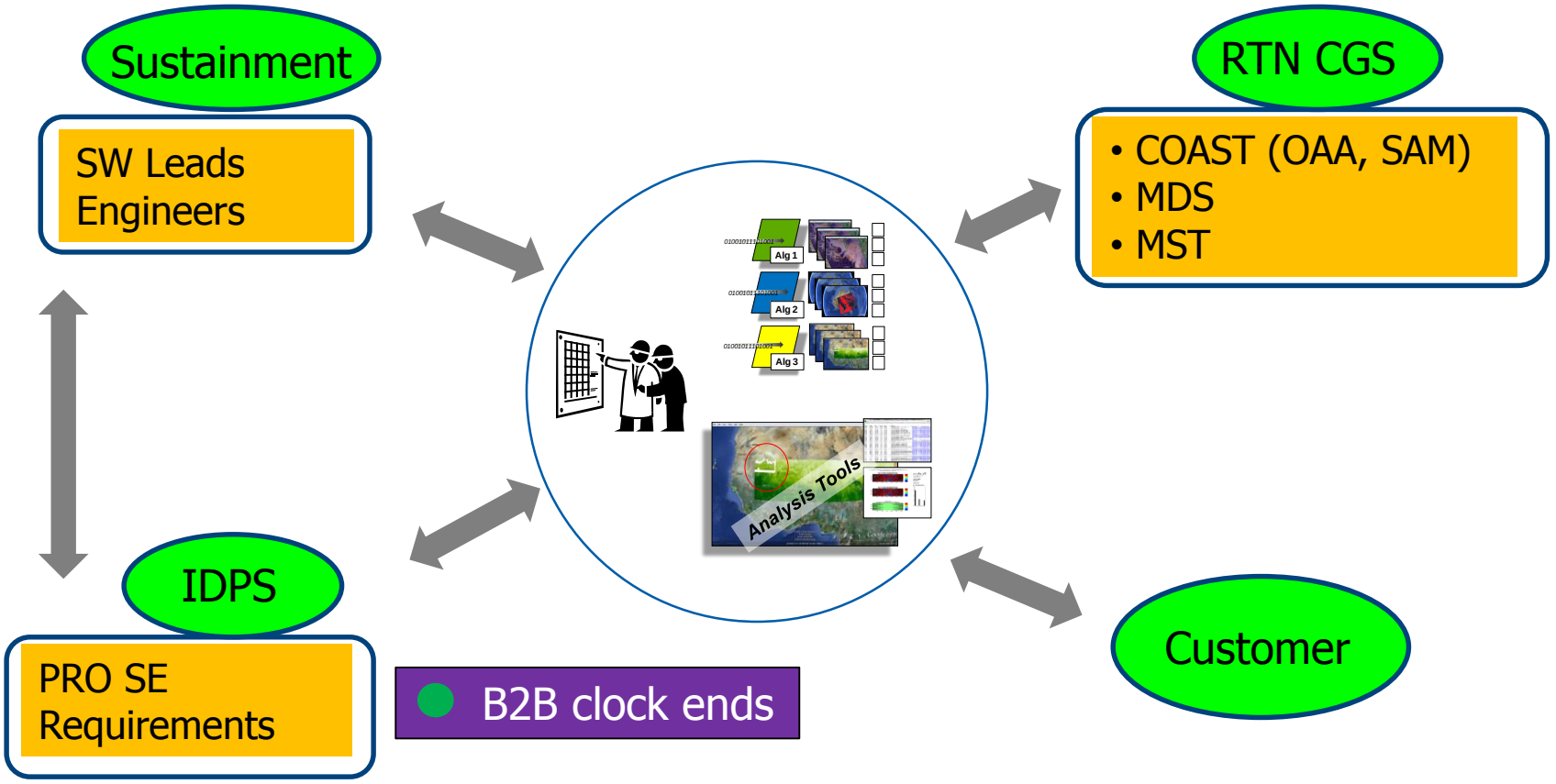
Build-2-Build Assessment (10/11) - B2B Analysis

- (**T**)arget/(**T**)rack
  - Implement focused monitoring (spatial, temporal, phenomenology)
  - Engineering judgment, collaboration (science knowledge-base)



Build-2-Build Assessment (11/11) - B2B Analysis, Communication

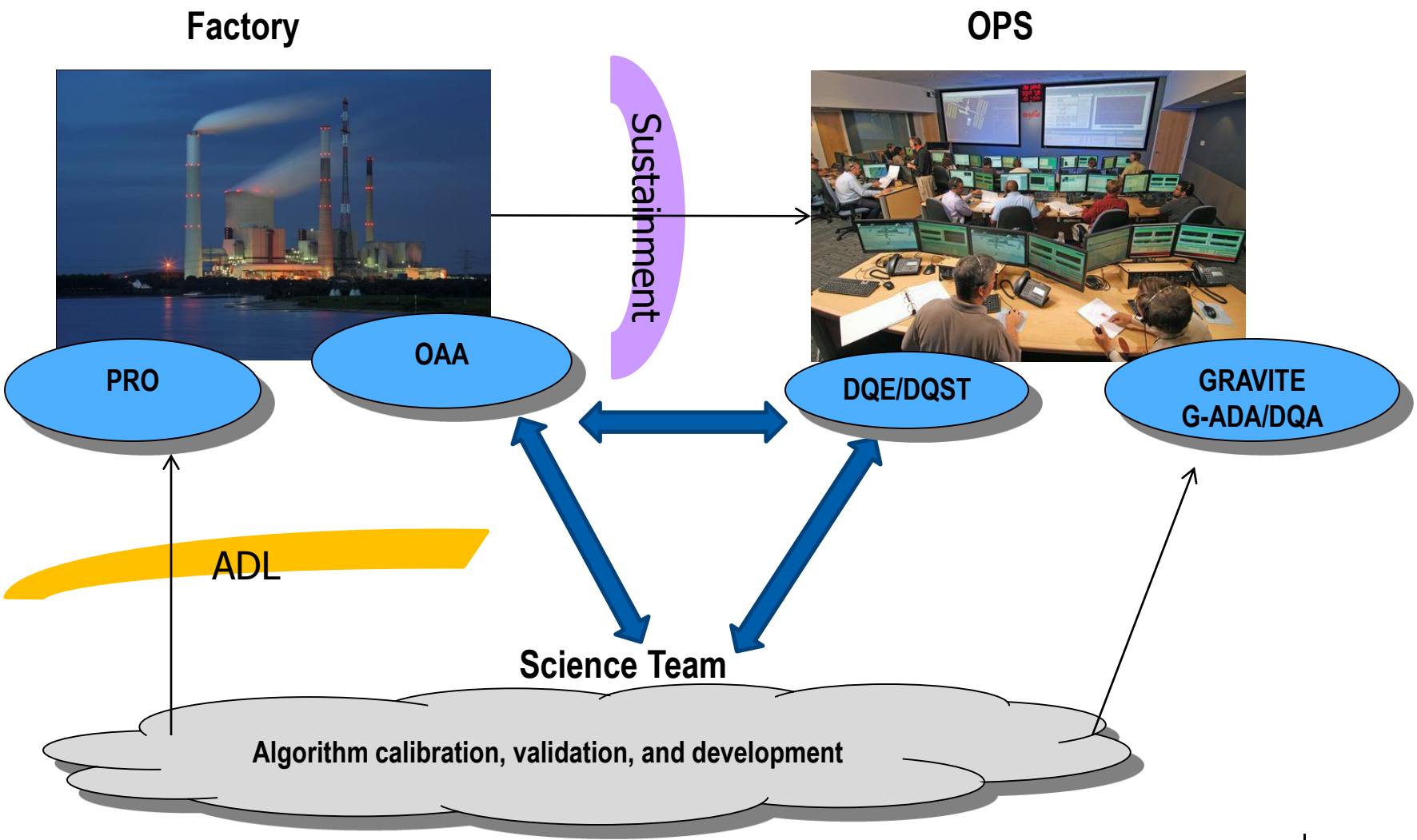
- (**E**)ngage/(**A**)ssess
  - Customers, management, mission partners (result-based)



BACKUP
OAA TOOL SUITE

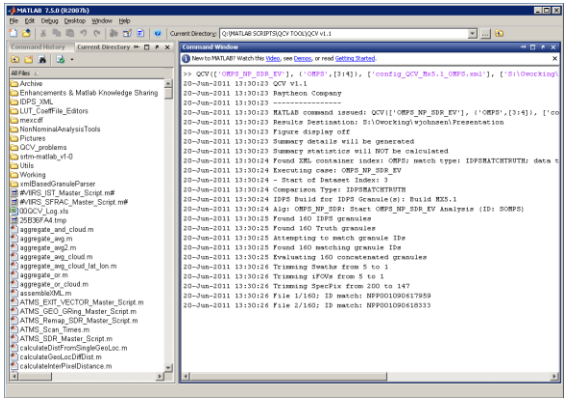
OAA Tool Suite (1/7)

Logical View

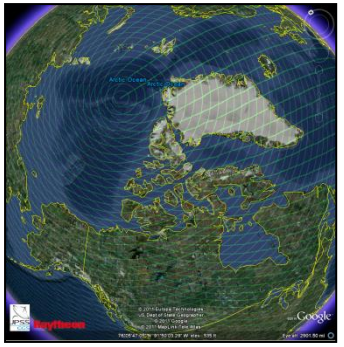


OAA Tool Suite (2/7)

- Qualitative and quantitative analysis of IDPS Operational data products
- Sophisticated MATLAB-based tool (CMD line)
- Individual granule or batch-level execution
- XML-based data format and analysis configuration
- Compares IDPS to IDPS or Science output results

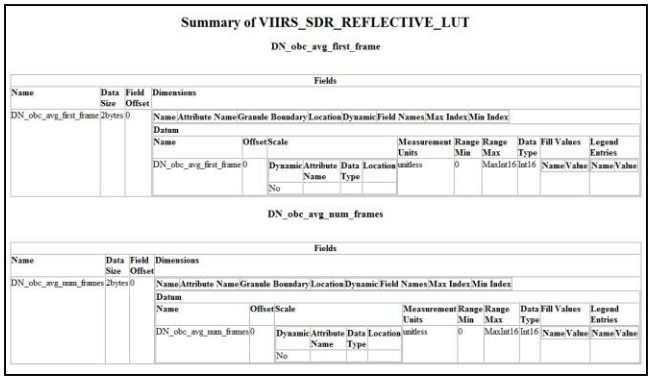


- Statistics for Single Granule and full dataset (multiple granules)
- Analysis results are quickly summarized and immediately accessible via spreadsheet templates
- Visualization aides include Google Earth KML/KMZ



OAA Tool Suite (3/7)

- Data Sources
  - Operational HDF5 files
    - Flexible data input using SW configuration XML (DDS, PRO)
  - Operational DMS savesets
    - Reads DMS savesets using SW configuration XML (DDS, PRO)
  - Operational Binaries
    - Binary-2-ASCII-2-Binary conversion
    - Provides Binary evaluation and manipulation
  - Non-operational formats
    - netCDF
    - HDF4
    - ASCII



Summary of VIIRS_SDR_REFLECTIVE_LUT

DN_obc_avg_first_frame

Fields																									
Name	Data Size	Field Offset	Dimensions																						
			Name	Attribute Name	Granule Boundary	Location	Dynamic	Field Names	Max Index	Min Index															
DN_obc_avg_first_frame	2bytes	0	Datum																						
			Name		Offset	Scale					Measurement Units	Range Min	Range Max	Data Type	Fill Values		Legend Entries								
			DN_obc_avg_first_frame		0		Dynamic	Attribute Name	Data Type	Location	unitless	0	MaxInt16	Int16											
							No																		

DN_obc_avg_num_frames

Fields																									
Name	Data Size	Field Offset	Dimensions																						
			Name	Attribute Name	Granule Boundary	Location	Dynamic	Field Names	Max Index	Min Index															
DN_obc_avg_num_frames	2bytes	0	Datum																						
			Name		Offset	Scale					Measurement Units	Range Min	Range Max	Data Type	Fill Values		Legend Entries								
			DN_obc_avg_num_frames		0		Dynamic	Attribute Name	Data Type	Location	unitless	0	MaxInt16	Int16											
							No																		

```
27-Jun-2011 15:54:49 Attempting to locate DDS XML file for CSN [VI
27-Jun-2011 15:54:50 Found MATLAB DDS XML format savefile [Q:\MATL
27-Jun-2011 15:54:50 Attempting to locate PRO XML file [VIIRS_I2_S
27-Jun-2011 15:54:53 Found MATLAB PRO XML format savefile [Q:\MATL
27-Jun-2011 15:54:53 Resolving metadata
27-Jun-2011 15:54:53 65 metadata items extracted
27-Jun-2011 15:54:55 Successfully read IDPS data in HDF5 format fo
27-Jun-2011 15:54:55 Traversing PRO XML structure: extracting arra
27-Jun-2011 15:54:55 found [radiance Factors] factors reference in
27-Jun-2011 15:54:55 found [Bt_refl Factors] factors reference in
27-Jun-2011 15:54:56 15 bit field(s) extracted
27-Jun-2011 15:54:56 3 spare bit field(s) extracted
27-Jun-2011 15:54:56 1 pad field(s) skipped
27-Jun-2011 15:54:56 Read of [GIMGO-SVI01-SVI02-SVI03-SVI04-SVI05_
>> data(1)

ans =

                ID: 'VIIRS-I2-SDR'
              path: '/All_Data/VIIRS-I2-SDR_All'
          pathtype: 'DataArray'
       parentindex: []
              name: 'Radiance'
           dmsname: []
         valuetype: 'uint16'
      valuedefault: []
    valuefactorsref: 15
          valueuom: 'Watts/(m^2 micrometer sr)'
     valuerangemin: '0'
     valuerangemax: '1800'
            offset: []
              size: [1536 6400]
             value: [6400x1536 uint16]
        sizeNames: ('I_VIIRS_SDR_ROWS'  'I_VIIRS_SDR_COLS')

>>
```

OAA Tool Suite (4/7)

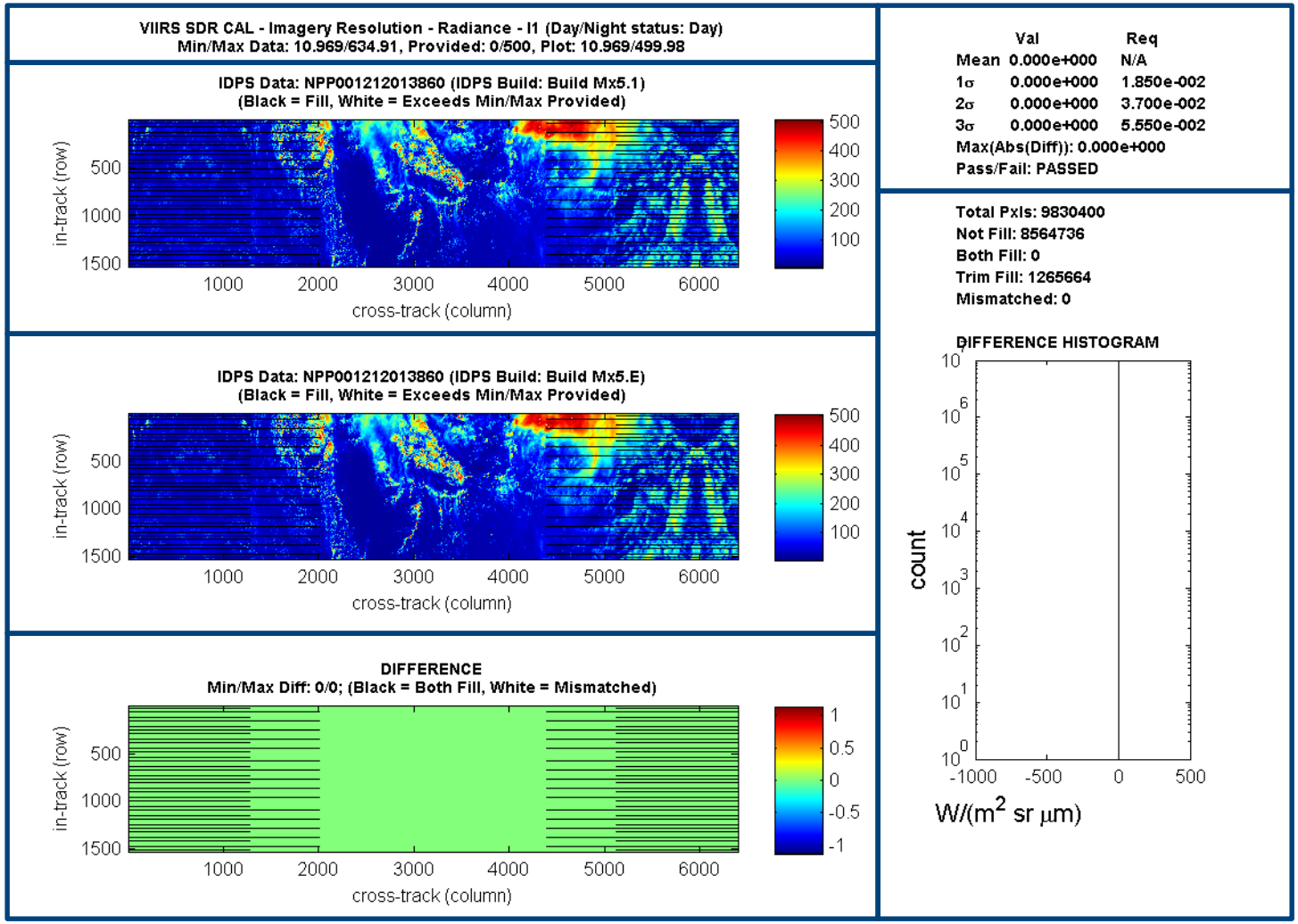
Example – VIIRS SDR

Title

Reference

To be verified

Difference

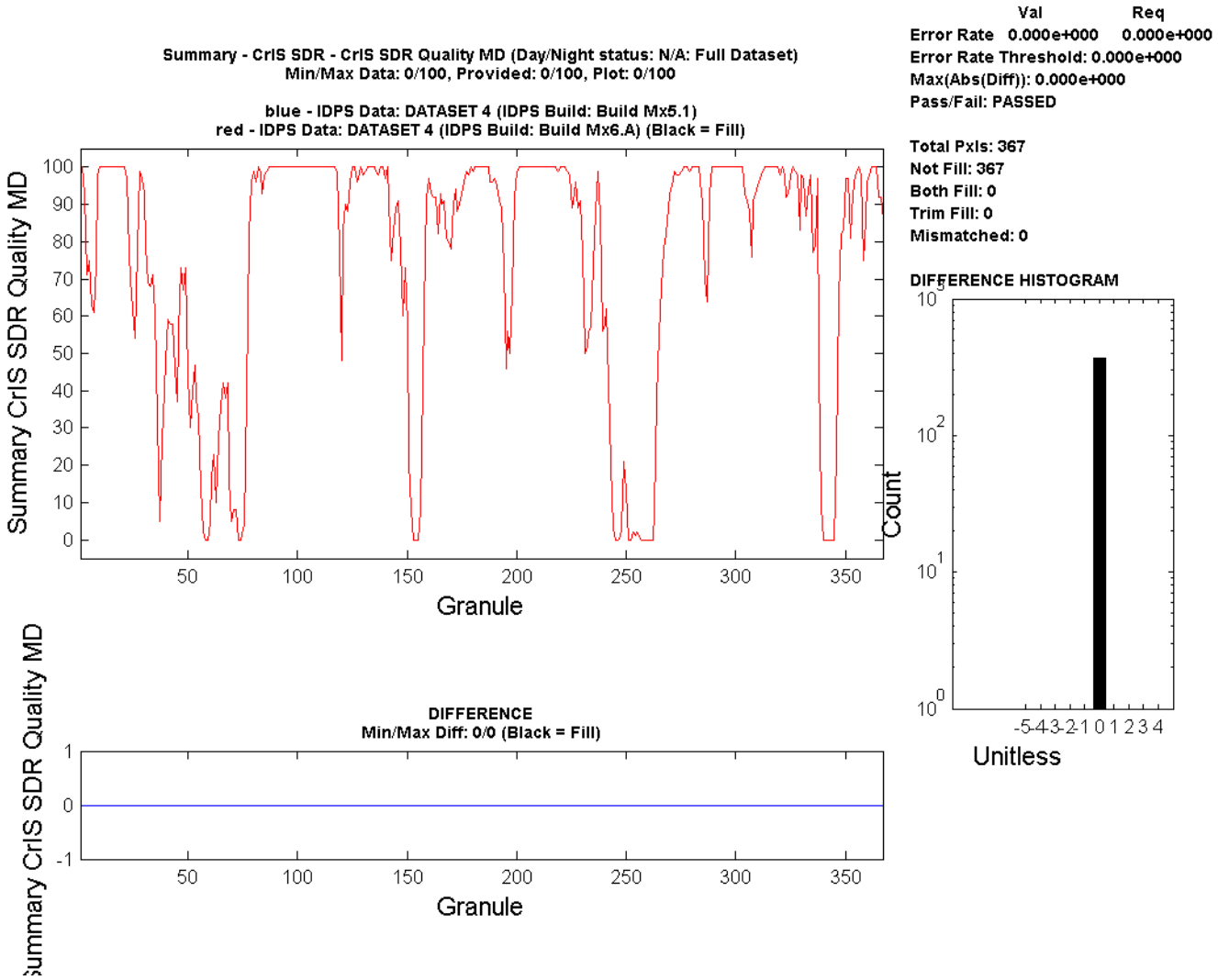


Statistics

Pixel Counts and Difference Histogram

OAA Tool Suite (5/7)

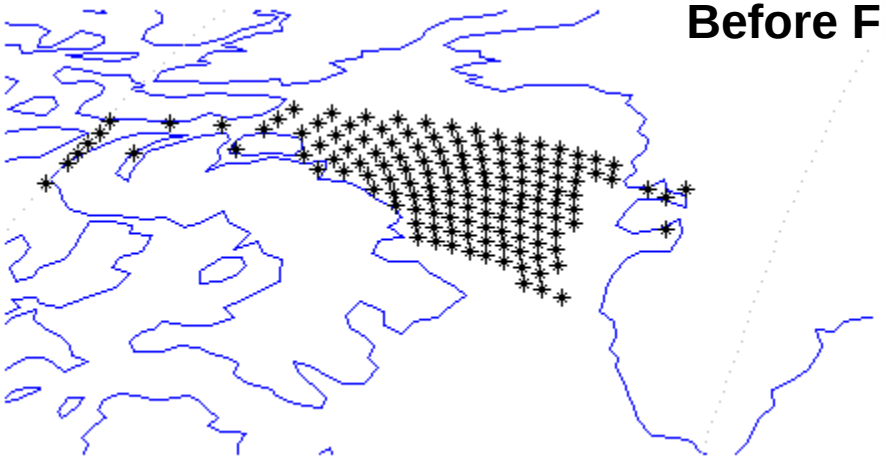
Example – 2-D plot



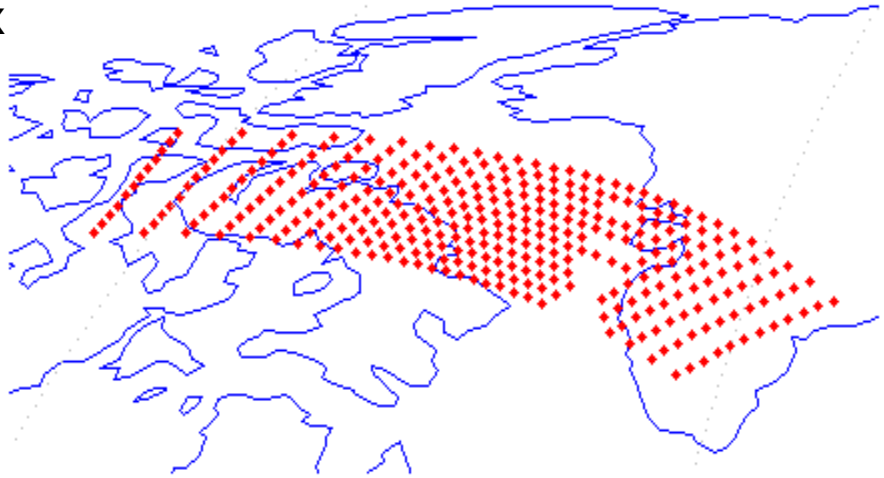
OAA Tool Suite (6/7)

- CrIMSS EDR Ice Mask QF incorrectly reporting ice on water surface (accounts for land also), DR 4400

Before Fix

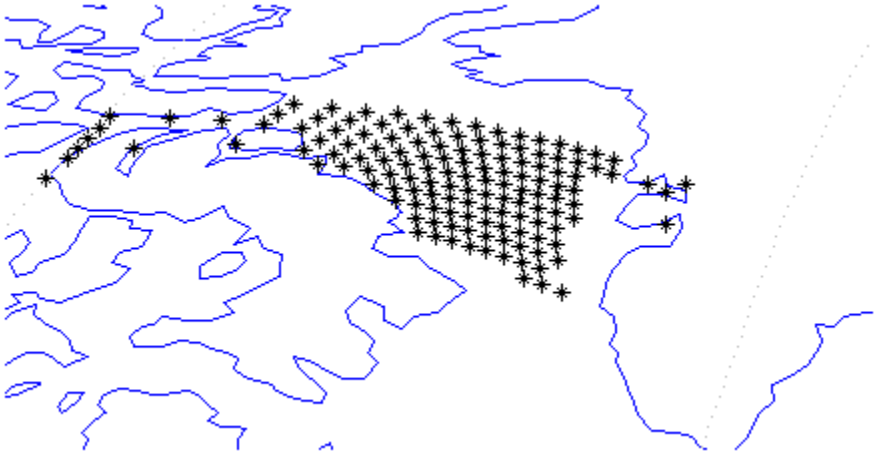


VIIRS Ice Detection

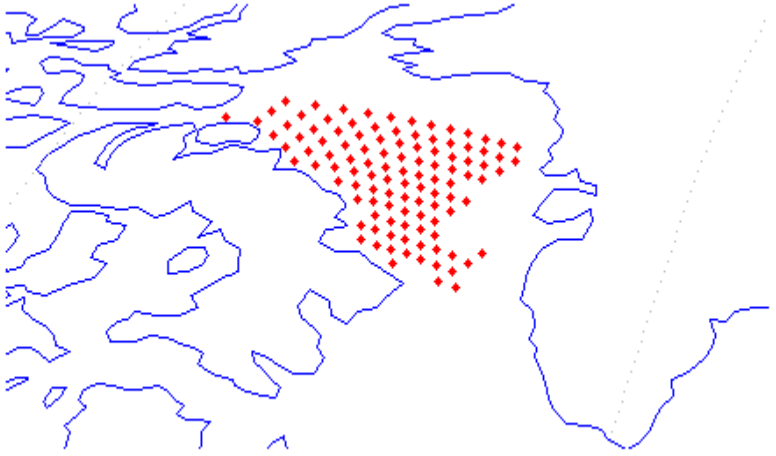


CrIMSS Ice Mask QF

After Fix



VIIRS Ice Detection

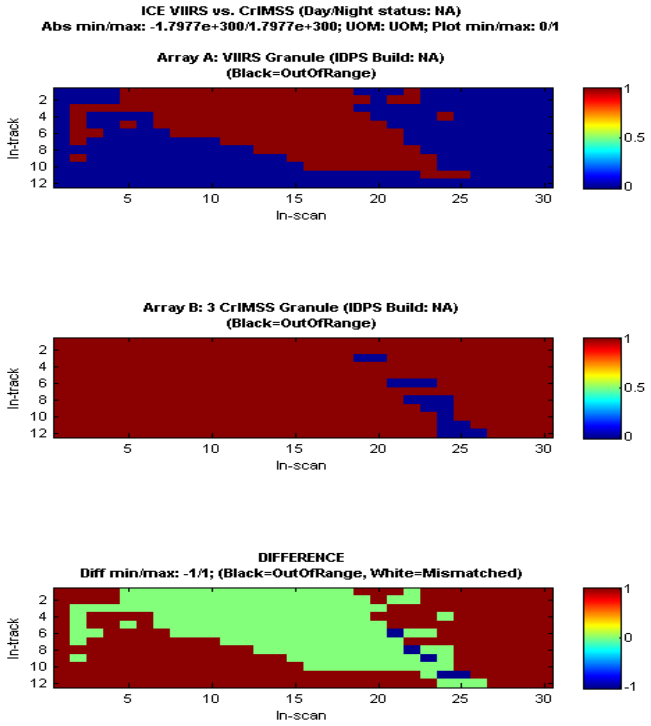


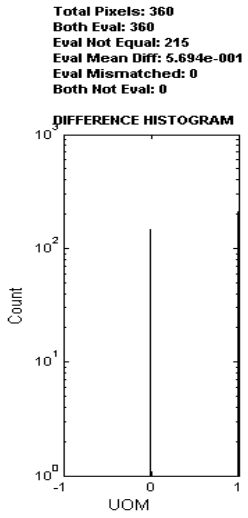
CrIMSS Ice Mask QF

OAA Tool Suite (7/7)

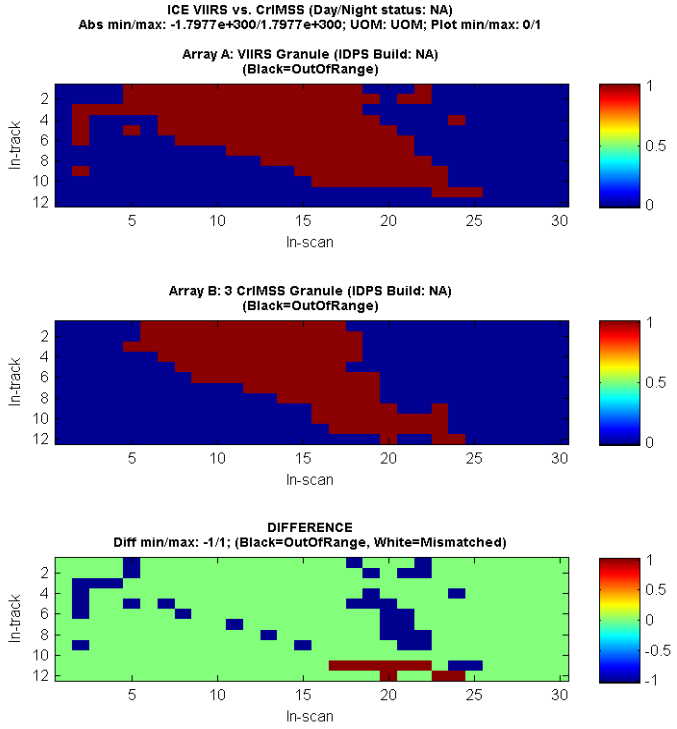
- CrIMSS Ice Detection QF Verification
  - Comparing CrIMSS Ice Detection QF to VIIRS Ice Fraction in VIIRS-I-Conc-IP

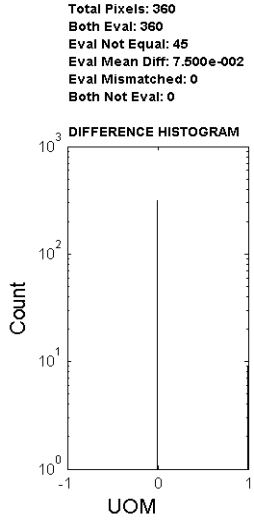
Before Fix





After Fix





BACKUP
FOCUS-DAY DATASET

Focus-Day Dataset (1/9) - Methodology

- Re-use experience gained working with proxy datasets to identify a methodology (*requirements*, tools, approach, analyses, etc.) that will lead to the identification of a Focus-Day dataset
  - Selected VIIRS granules
  - 2 orbits worth of CrIMSS/OMPS granules
- Ensure methodology is easily duplicated – bearing in mind that more Focus Days will be forthcoming, hence, the need for more datasets

Focus-Day Dataset (2/9) - Approach (1/4)

- First, use the May 15th, 2012 Focus Day as the "Data Mining" field to "Search, Characterize and Identify" those granules of interest - good representatives of the VIIRS chain algorithm characteristics and QFs -according to predefined criteria:
  - **Tropical day, some non-cloudy ocean, some non-cloudy land** — **1a|1b**
  - **Mid-lat day, some non-cloudy ocean, some non-cloudy land** — **2a|2b**
  - **Polar day, some non-cloudy ice, some non-cloudy snow** — **3**
  - **Tropical night, some non-cloudy ocean, some non-cloudy land** — **4a|4b**
  - **Mid-lat night, some non-cloudy ocean, some non-cloudy land** — **5a|5b**
  - **Polar night, some non-cloudy ice, some non-cloudy snow** — **6**
  - **Sun glint** — **7**
  - **All-land** — **8**
  - **All-ocean** — **9**
  - **Terminator** — **10**
  - **SZA thresholds:**
    - **85 degrees (most day-only EDRs)** — **11a**
    - **89 degrees (SDR Refl)** — **11b**
    - **70 deg (OCC, ST)** — **11c**
    - **80 deg (AOT, SM)** — **11d**
  - **SAA** — **12**
  - **VIIRS SDR saturation (M6)** — **13**

Focus-Day Dataset (3/9) - Approach (2/4)

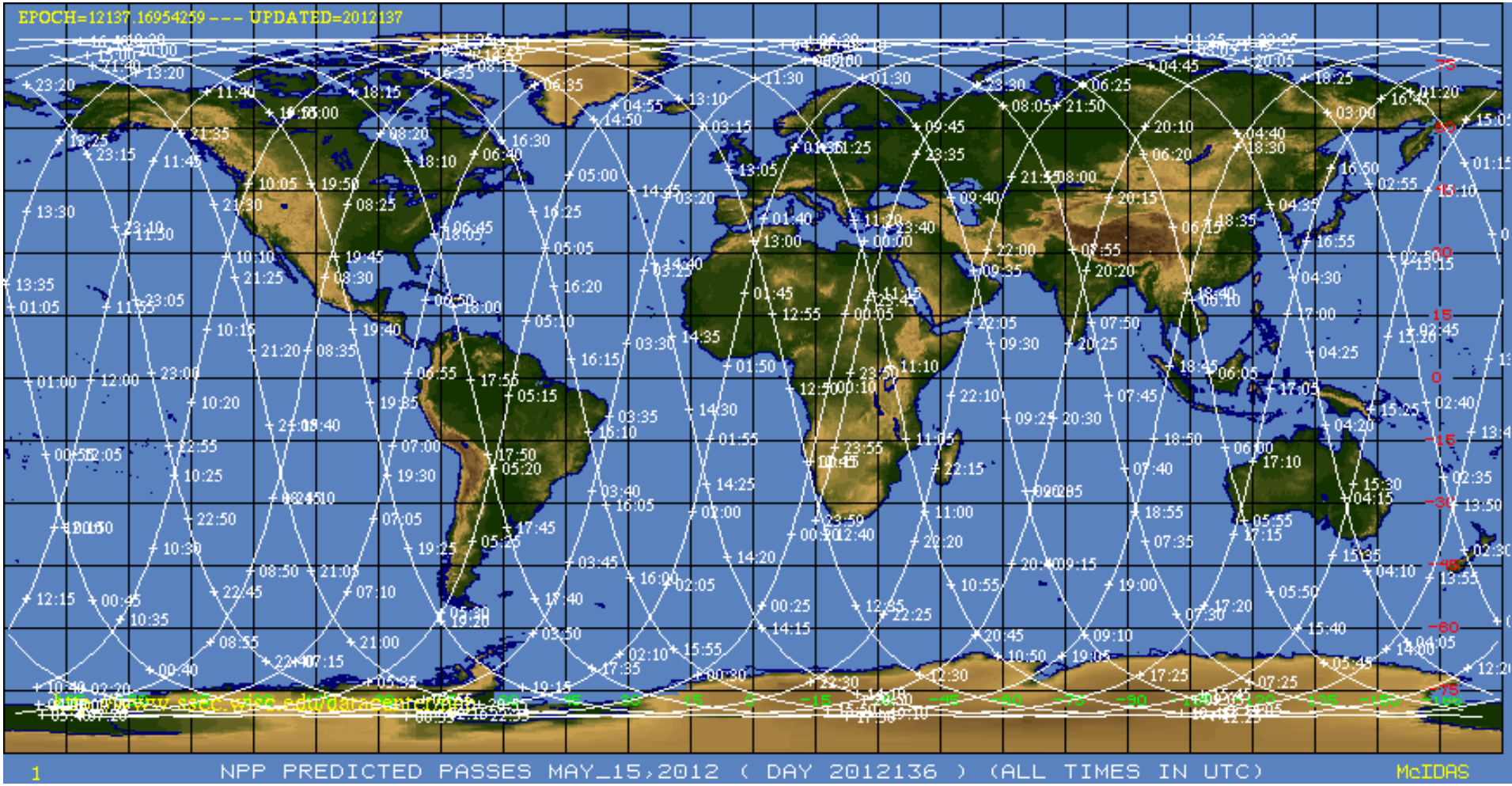
- Second, identify granules that may have any of the following behavior (if none found, then identify candidate granules to modify to trigger this behavior, i.e., non-nominal):
  - **Bad Detector(s)**
  - **Missing A&E data**
  - **VIIRS Carefully Designed Catastrophic Non-Nominal (CDCNN)**
    - Remove specific VIIRS EV, Cal, and Eng/Thermal packets through a single granule to trigger as many fill and QF conditions as possible throughout the chain
    - Example:
      - Missing EV AP in M15 band: Affects SDR, Imagery EDR, IST EDR, LST EDR, SST EDR
      - Missing EV AP in I1 bnd: Affects SDR, Imagery EDR, SIC EDR. Snow EDRs, VI EDR
      - Missing CAL AP in M5 band: Affects SDR and cloud EDR QFs

Focus-Day Dataset (4/9) - Approach (3/4)

- Third, augment the identified granules/datasets "within the May 15th, 2012 Focus Day" with additional granules/datasets "outside of the May 15th, 2012 Focus Day" to account for the following characteristics:
  - **Solar/Lunar Eclipses**
  - **Maneuver**

Focus-Day Dataset (5/9) - Approach (4/4)

NPP Orbits – May 15th, 2012 Focus Day

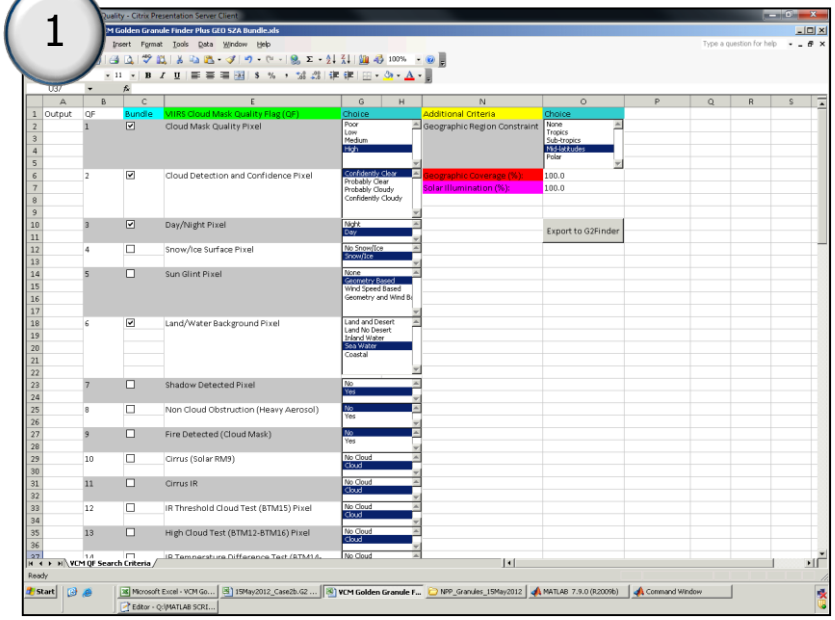


Focus-Day Dataset (6/9) - "Data Mining" Tool (1/4)

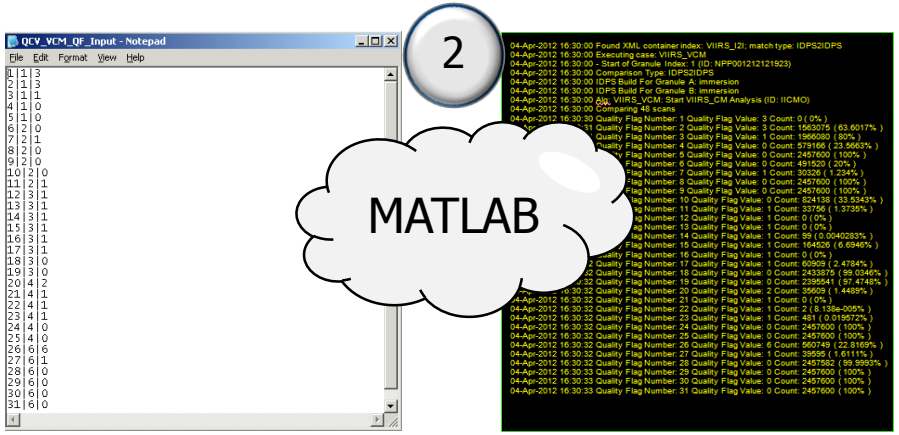
- Exploit VIIRS Cloud Mask Quality Flag IP
  - "Canary" algorithm; major influence on downstream algorithms
- Link VCM QF characterization with "logical ANDs"
  - Include geolocation, sun-earth-satellite geometry, misc. metadata
- Employ COTS tools to collectively determine NPP Selected Granules
  - GUI: Macro-enabled Excel Worksheet
  - Analytics: MATLAB
  - Visualization: Google Earth
- Raytheon Data Quality Management-Lite (DQL) – KMZ
- Interactive Demonstration – "Case 2b"
  - **Mid-lat day, some non-cloudy ocean, some non-cloudy land** **2a|2b**

Focus-Day Dataset (7/9) - "Data Mining" Tool (2/4)

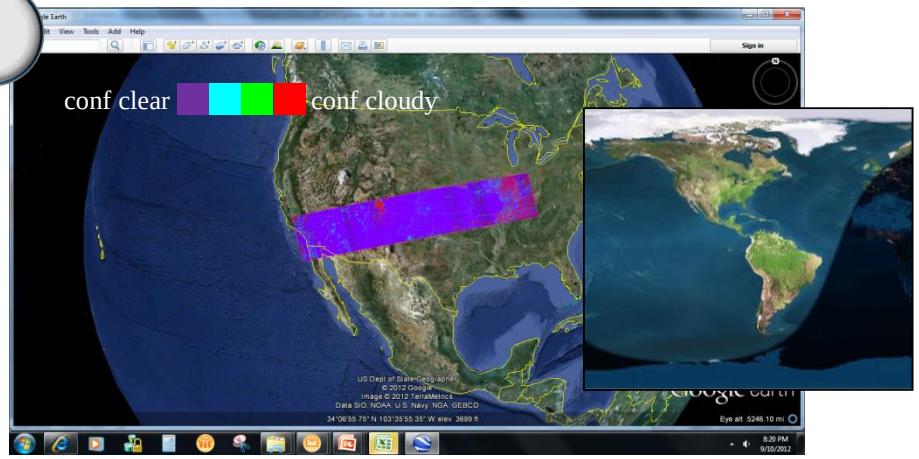
1



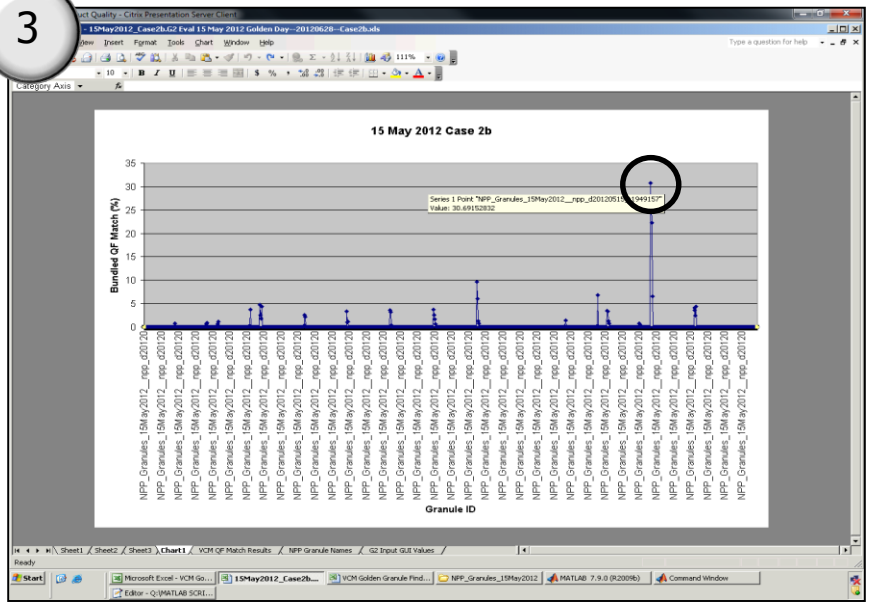
2



4



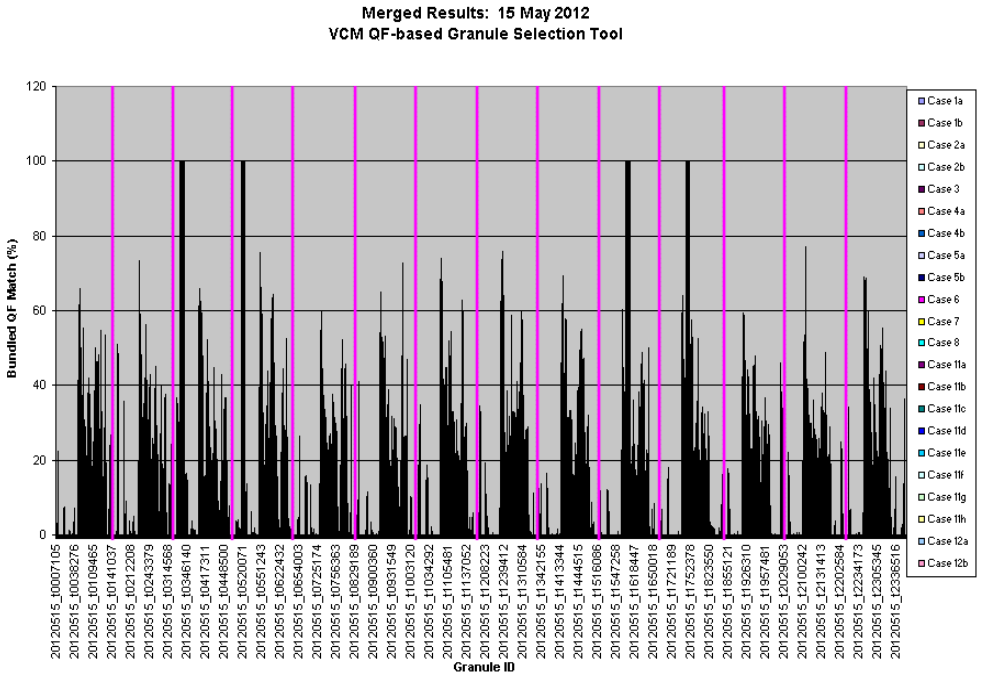
3



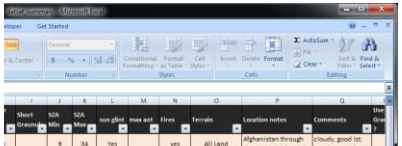
Focus-Day Dataset (8/9) - "Data Mining" Tool (3/4)

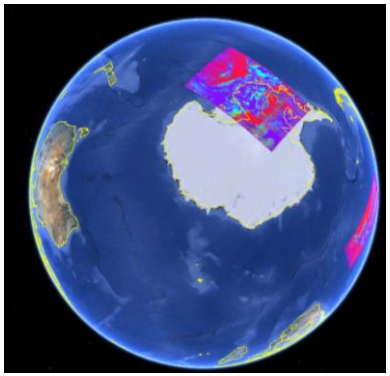
Mid-lat day, some non-cloudy ocean, some non-cloudy land 2a | 2b

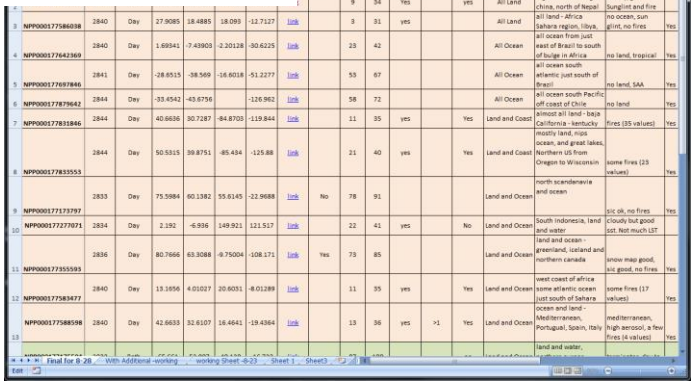
Focus-Day Dataset (9/9) - "Data Mining" Tool (4/4)



- Unique approach and combination of tools enabled quick, quantitative, and effective identification of S-NPP VIIRS Selective Granules
- Rapid interrogation, visualization, and result sharing







BACKUP
COLLABORATIVE CASE STUDY

Case Study – VIIRS RSB Auto Cal (1/3)

- Very tight schedule, all participants worked rapidly to implement
- Some elements of the consultation approach were exercised, and some were not
  - Collaboration was used to help compress schedule and reduce technical risk
- Areas of Success
  - DPA/Raytheon coordinated TIMs early on which helped both sides to understand the science and operational aspects of the algorithm updates
  - Early collaboration with science team on ADL compliance resulted in plug-and-play integration into IDPS (1/2 day worth of SW effort)
    - Code exchange helped both teams; Raytheon learned science aspects and scientist gained insights into operational aspects
    - Close collaboration enabled early problem identification and rapid resolution
      - Issues identified; PCRs written and closed in same build
    - Major contributor to schedule mitigation

Case Study – VIIRS RSB Auto Cal (2/3)

- Areas of "Lack of Success"
  - Lack of collaboration/consultation on interfaces or operability aspects outside the ADL framework; lack of early Raytheon SE involvement
    - Resulted in delays in deployment of Mx 8.0
    - Cross algorithm issues were not addressed in science code
    - Elements necessary for a successful RTN DDPR not identified early on
  - Test data and DPE test coordination incomplete
    - Unit test at science level successful
    - Integration test at DPE level problematic
      - DPE test engineer not involved until test execution
  - Algorithm Data Package review between DPE and Raytheon would have detected missing elements
    - Large, complex package with limited documentation
    - No test procedures
    - Product output changed without coordination
    - Integration test issues not documented and provided to Raytheon
    - No feedback of RSB output into chain

Case Study – VIIRS RSB Auto Cal (3/3)

- Areas of "Lack of Success" (Cont.)
  - Early evaluation of size of change would have enabled better Raytheon planning for implementation and resource utilization
    - Rushed into operational integration
      - Insufficient memory testing
      - Skipped integrated algorithm testing during unit test phase (waited until integrated build testing)
      - Numerous over-indexing issues
      - Limited error handling and optimization performed

Early Collaboration Led to Success
Lack of Collaboration Resulted in Problems

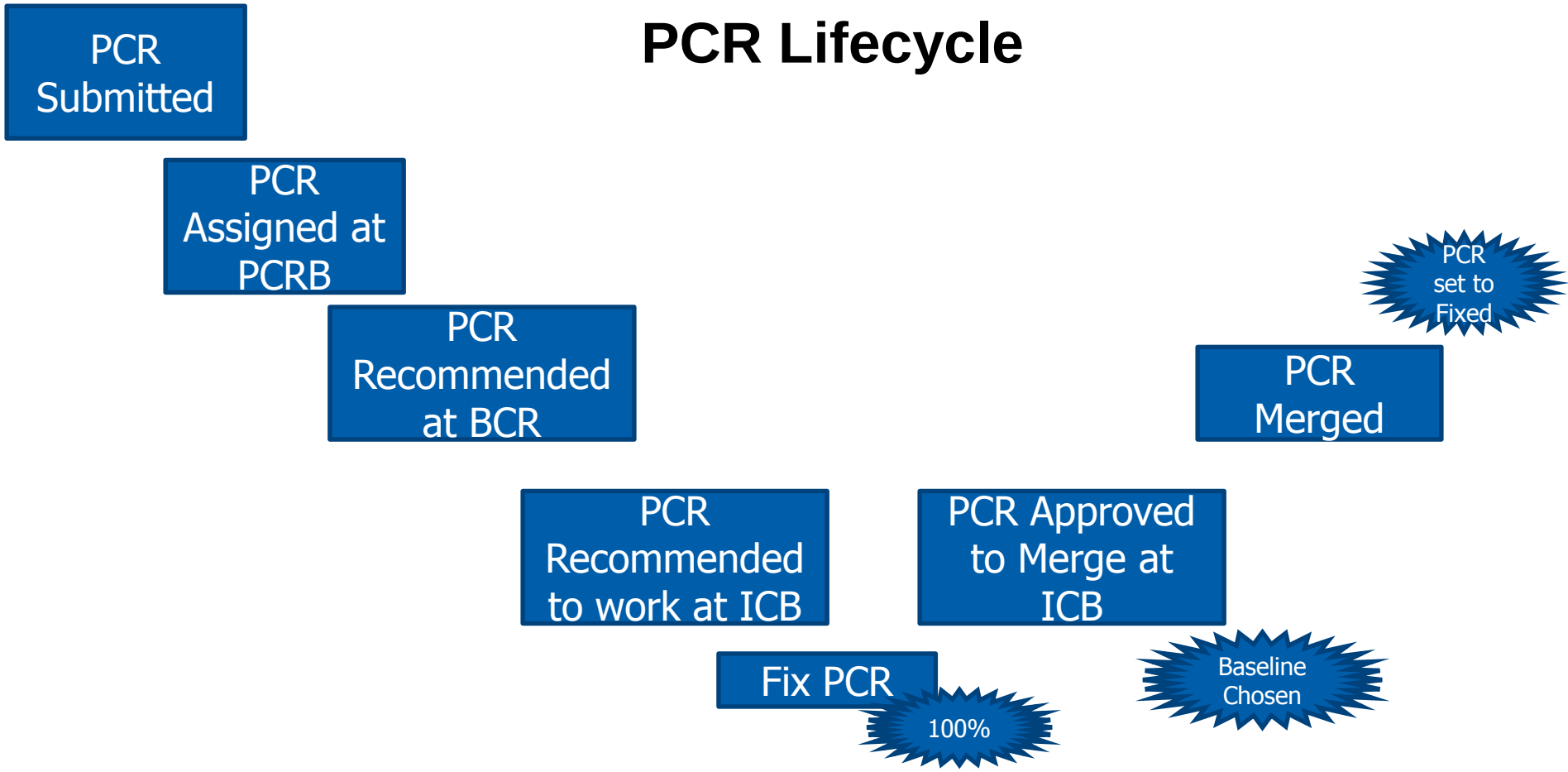
BACKUP
CONSOLIDATED ARC

Accelerated Release Cycle (1/5)

- Consolidated ARC Process
  - CCR work is approved through ICB for Sustainment Mx inclusion
  - OAA, SE and SW evaluate impacts to NPP and J1 baseline
  - SW developer(s) assigned to Sustainment PCR
    - Sustainment PCR is cloned for Development via Sustainment PCRB
  - SW developer(s) completes Sustainment work
    - Development PCR is worked once Sustainment work is complete
    - OAA supports UT analysis, PCR verification
  - Both PCR changes are merged to Sustainment and Development branches

Accelerated Release Cycle (2/5)

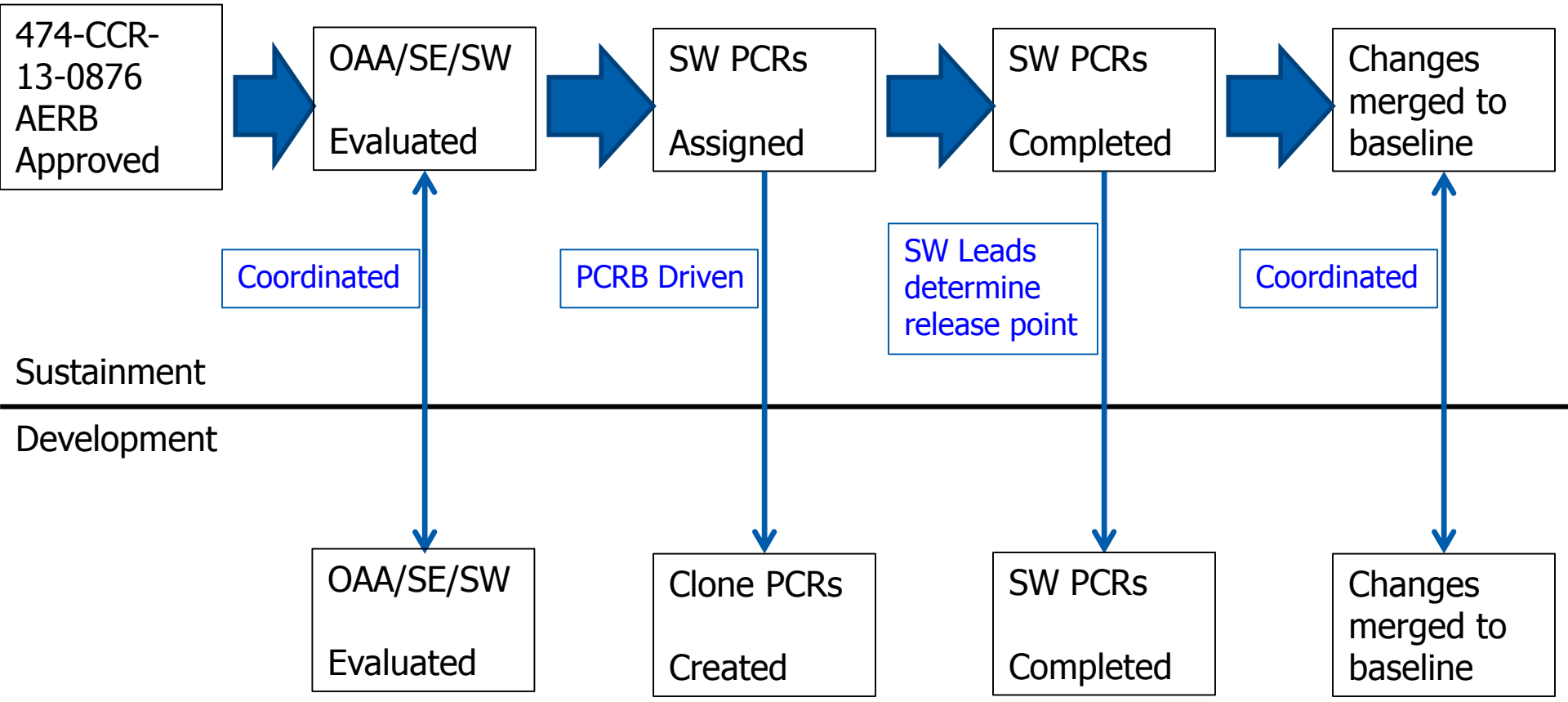
PCR Lifecycle



Update % Complete field every week. Those PCRs that are 100% go to the ICB

Accelerated Release Cycle (3/5)

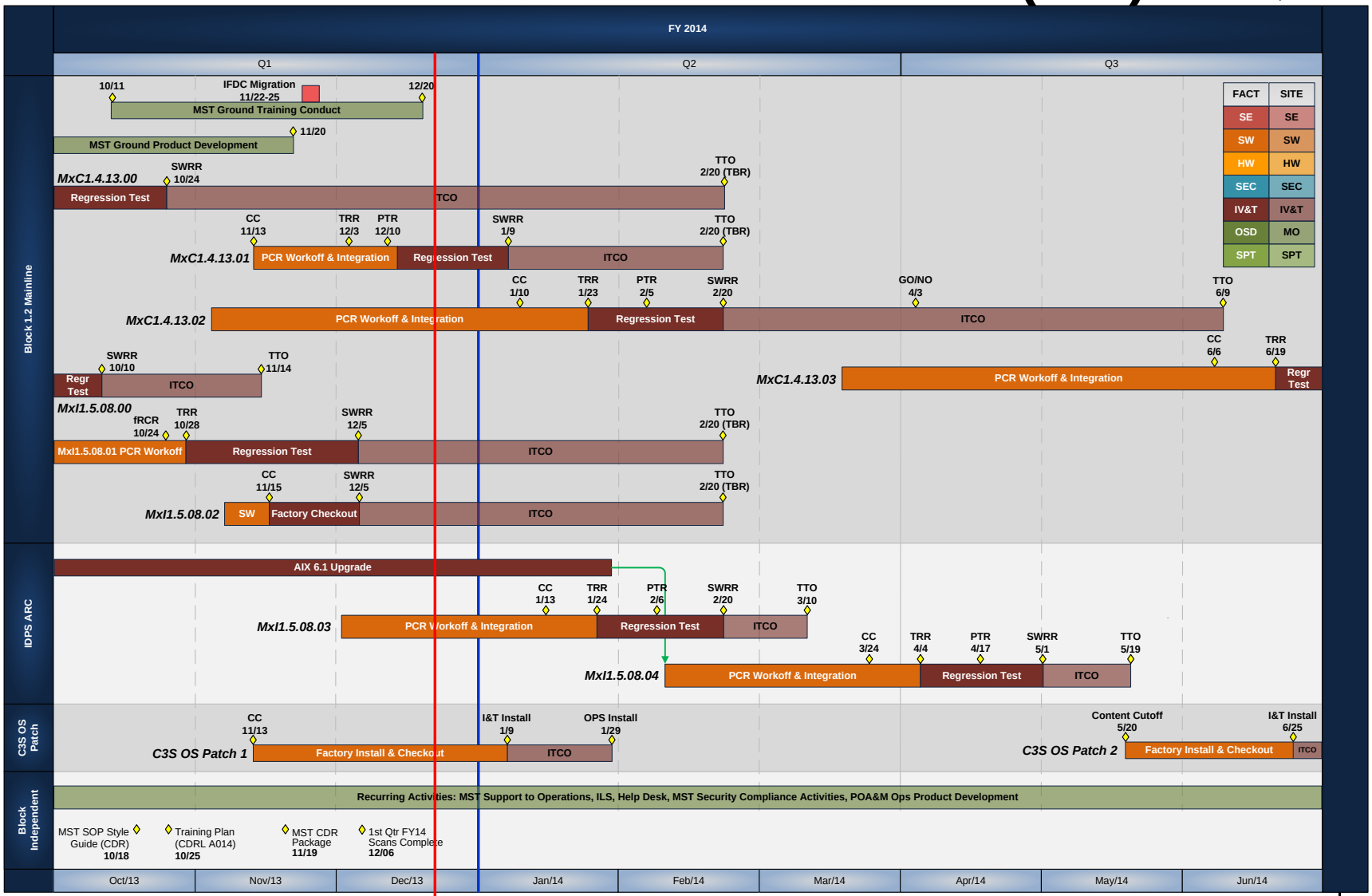
Process Flow Example – CCR 876 VIIRS SDR RSB Auto Cal



Accelerated Release Cycle (4/5)

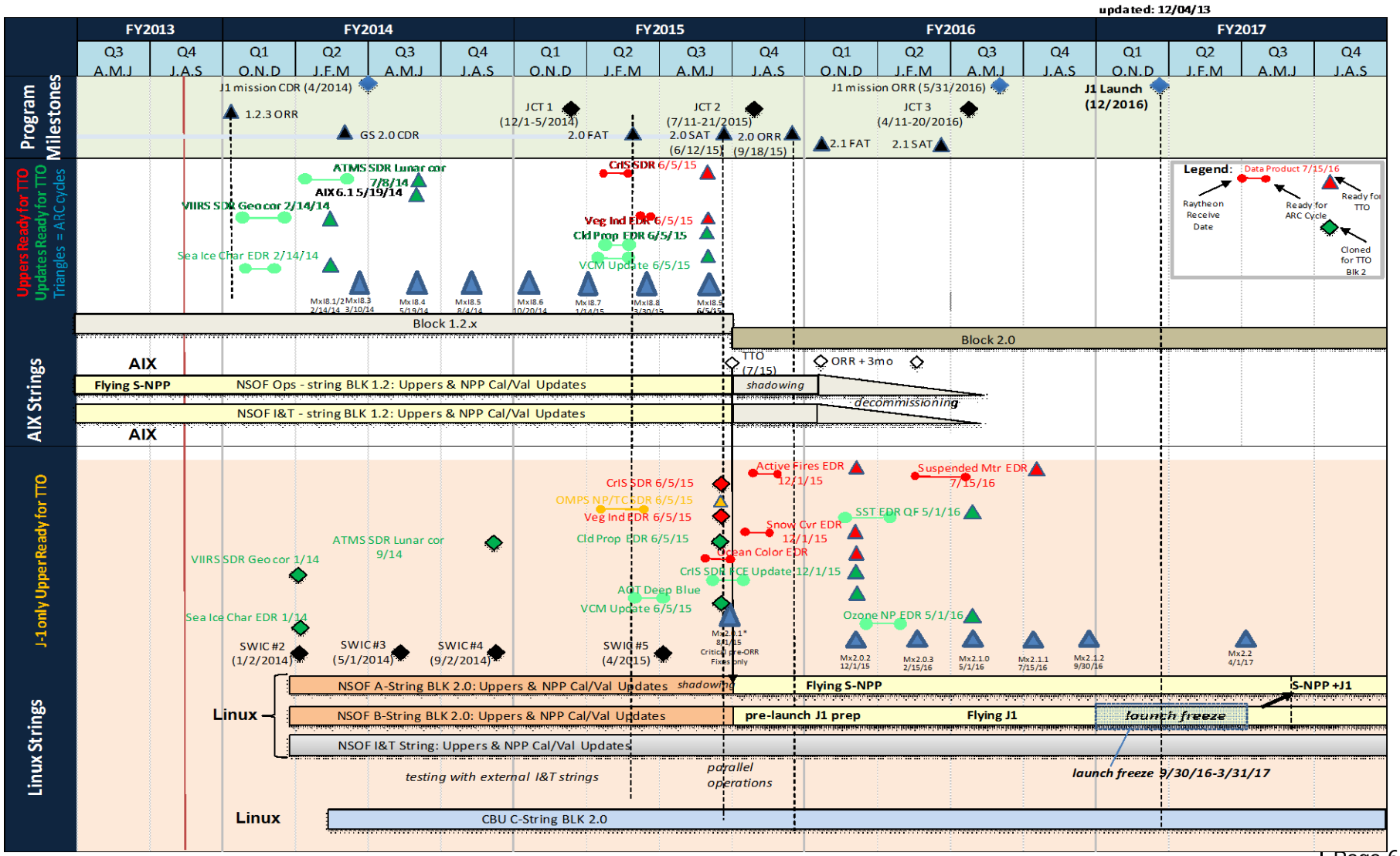
Sustainment Detailed Timeline (v80)

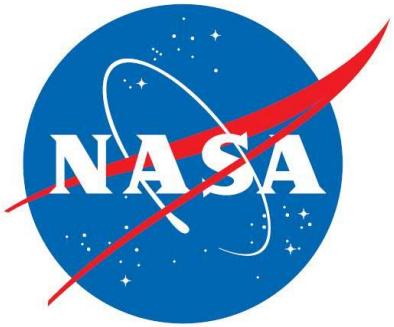
Updated 12/1/13



Accelerated Release Cycle (5/5)

Algorithm Implementation Timeline (Courtesy of: JPSS SE – R. Morgenstern)





Raytheon